

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION
(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing: 25 November 1999 (25.11.99)	
International application No.: PCT/FI99/00421	Applicant's or agent's file reference: MH/FI981125
International filing date: 17 May 1999 (17.05.99)	Priority date: 20 May 1998 (20.05.98)
Applicant: VENÄLÄINEN, Teuvo, Olavi	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International preliminary Examining Authority on:

23 September 1999 (23.09.99)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer: J. Zahra Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference MH/FI981125	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI99/00421	International filing date (<i>day/month/year</i>) 17.05.1999	Priority date (<i>day/month/year</i>) 20.05.1998
International Patent Classification (IPC) or national classification and IPC7 B21D 1/12, G01B 5/00		
Applicant AUTOROBOT FINLAND OY et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 23.09.1999	Date of completion of this report 17.04.2000
Name and mailing address of the IPEA/SE Patent- och registreringsverket Telex Box 5055 17978 S-102 42 STOCKHOLM PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Katarina Ekman/MP Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI99/00421

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

- ☒ the international application as originally filed.
- ☐ the description, pages _____, as originally filed,
 pages _____, filed with the demand,
 pages _____, filed with the letter of _____,
 pages _____, filed with the letter of _____.
- ☐ the claims, Nos. _____, as originally filed,
 Nos. _____, as amended under Article 19,
 Nos. _____, filed with the demand,
 Nos. _____, filed with the letter of _____,
 Nos. _____, filed with the letter of _____.
- ☐ the drawings, sheets/fig _____, as originally filed,
 sheets/fig _____, filed with the demand
 sheets/fig _____, filed with the letter of _____,
 sheets/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI99/00421

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-10</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-10</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-10</u>	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates to measurement apparatus and method in vehicle body alignment work in measurement of a vehicle body.

An object of the invention is to provide a flexible measurement unit, comprising separate articulated arms, and a measurement head connected to the end of the arm parts. The measurement head has several degrees of freedom and can be brought to measurement points inside a vehicle.

None of the documents cited in the International Search Report is considered to anticipate the invention as stated in claims 1-10.

Therefore, the subject matter of the claims 1-10 is novel, and is considered to involve an inventive step and to have industrial applicability.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI99/00421

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The measurement head is given the reference number 65 in the figures but number 64 and 65 in the description.

PATENT COOPERATION TREATY

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference MH/FI981125	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> FOR FURTHER ACTION </div> <div style="font-size: small;"> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. </div> </div>	
International application No. PCT/FI 99/00421	International filing date (<i>day/month/year</i>) 17 May 1999	(Earliest) Priority Date (<i>day/month/year</i>) 20 May 1998
Applicant Autorobot Finland Oy et al		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (See Box I).

2. ☐ Unity of invention is lacking (See Box II).

3. ☐ The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.
☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ transcribed by this Authority.

4. With regard to the title, ☒ the text is approved as submitted by the applicant.
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant.
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:

Figure No. 3A

☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.
☐ because this figure better characterizes the invention.

1
INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00421

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B21D 1/12, G01B 5/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B21D, G01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5148377 A (MCDONALD), 15 Sept 1992 (15.09.92), figure 10, abstract --	1-10
A	US 4953306 A (WECKENMANN ET AL), 4 Sept 1990 (04.09.90), figure 9 --	1-10
A	GB 2100681 A (SAMEFA AG), 6 January 1983 (06.01.83), figures 1,5, claim 1, abstract --	1-10
A	FR 2703447 A1 (CELETTE PRODUCTIONS (S.A.)), 7 October 1994 (07.10.94), figure 1, abstract -- -----	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

19 August 1999

Date of mailing of the international search report

23 -08- 1999

Name and mailing address of the ISA
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Katarina Ekman
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/08/99

International application No.

PCT/FI 99/00421

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5148377 A	15/09/92	AU 619171 B AU 1054688 A CA 1299362 A EP 0334890 A JP 2501591 T WO 8804404 A	23/01/92 30/06/88 28/04/92 04/10/89 31/05/90 16/06/88
US 4953306 A	04/09/90	DE 3714862 A,C DE 3875790 A EP 0289983 A,B SE 0289983 T3 JP 63285407 A	17/11/88 17/12/92 09/11/88 22/11/88
GB 2100681 A	06/01/83	NONE	
FR 2703447 A1	07/10/94	NONE	

RECORD COPY

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only	
PCT/FI 99 / 00421	
International Application No.	
International Filing Date	17 MAY 1999 (17. 05. 99)
The Finnish Patent Office. PCT International Application	
Name of receiving Office and "PCT International Application"	
Applicant's or agent's file reference (if desired) (12 characters maximum) MH/FI981125	

Box No. I TITLE OF INVENTION	
Equipment and method of measurement in vehicle body alignment work in vehicle body measurement	
Box No. II APPLICANT	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
AUTOROBOT FINLAND OY Yrittäjäntie 23 FIN-70150 KUOPIO Finland	<input type="checkbox"/> This person is also inventor. Telephone No. Facsimile No. Teleprinter No.
State (that is, country) of nationality: Finland	State (that is, country) of residence: Finland
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
VENÄLÄINEN Teuvo Olavi Kiuruntie 40 FIN-70340 KUOPIO Finland	This person is: <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)
State (that is, country) of nationality: Finland	State (that is, country) of residence: Finland
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<input type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: <input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
Forssén & Salomaa Oy Yrjönkatu 30 FIN-00100 Helsinki Finland	Telephone No. +358 9 615 3500 Facsimile No. +358 9 615 35111 Teleprinter No.
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

Regional Patent


- ☒ **AP ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|--|--|
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BG Bulgaria | <input checked="" type="checkbox"/> MN Mongolia |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GD Grenada | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> IN India | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> IS Iceland | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> JP Japan | <input checked="" type="checkbox"/> YU Yugoslavia |
| <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KG Kyrgyzstan | |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | |
| <input checked="" type="checkbox"/> KR Republic of Korea | |
| <input checked="" type="checkbox"/> KZ Kazakhstan | |
| <input checked="" type="checkbox"/> LC Saint Lucia | <input checked="" type="checkbox"/> AE United Arab Emirates |
| <input checked="" type="checkbox"/> LK Sri Lanka | <input checked="" type="checkbox"/> ZA South Africa |
| <input checked="" type="checkbox"/> LR Liberia | <input type="checkbox"/> |

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1) 20 May 1998(20-05-98)	981125	Finland (FI)		
item (2)				
item (3)				
<input checked="" type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): 981125				
<small>* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.</small>				
Box No. VII INTERNATIONAL SEARCHING AUTHORITY				
Choice of International Searching Authority (ISA) <small>(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):</small>		Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):		
ISA / SE		Date (day/month/year)	Number	Country (or regional Office)
Box No. VIII CHECK LIST; LANGUAGE OF FILING				
This international application contains the following number of sheets: request : 3 description (excluding sequence listing part) : 11 claims : 3 abstract : 1 drawings : 11 sequence listing part of description : Total number of sheets : 29		This international application is accompanied by the item(s) marked below: 1. <input checked="" type="checkbox"/> fee calculation sheet 2. <input type="checkbox"/> separate signed power of attorney 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input checked="" type="checkbox"/> other (specify): Official Action		
Figure of the drawings which should accompany the abstract: 3A		Language of filing of the international application: Finnish		
Box No. IX SIGNATURE OF APPLICANT OR AGENT				
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).				
FORSSÉN & SALOMAA OY  Mauri Herttuainen				

For receiving Office use only	
1. Date of actual receipt of the purported international application: 17 MAY 1999 (17-05-1999)	2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA / SE	
6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only	
Date of receipt of the record copy by the International Bureau: 75 JUNE 1999 (25.06.99)	

Mittauslaitteisto ja menetelmä autonkorin oikaisutyössä
autonkorin mittauksessa

5

Keksinnön kohteena on mittauslaitteisto ja menetelmä autonkorin oikaisutyössä autonkorin mittauksessa.

10

Keksinnön mukainen laiteratkaisu käsittää autonkorin oikaisulaitteen, jossa on oikaisupöytä, johon ajoneuvo kiinnikkeiden avulla kiinnitetään. Rakenne käsittää edullisesti nostolaitteen, jolla oikaisupöytä on nostettavissa halutulle oikaisukorkeudelle. Oikaisupöytään on liitettävissä ajoneuvon kytkeytyvät työkalut, kuten vetoriimut, edullisesti oikaisupuomien tai vastaavien kautta. Keksinnön mukainen laiteratkaisu käsittää mittalaitteiston, joka on sovitettavissa oikaistavan ajoneuvon ympärille. Mittalaitteisto käsittää pitkittäisjohteet, joiden varassa mittakaari ja siihen liittyvät mittausyksiköt ovat liikutettavissa. Pitkittäisjohteiden keskilinjoja X_1 vasten on kohtisuorasti poikittaisjohde tai poikittaisjohteet, jotka ovat liikutettavissa pitkittäisjohteen myötäisesti siitä ohjauksen saaneena ajoneuvon alapuolisten rakenteiden mittaamiseksi. Ne toimivat myös pitkittäisjohteet toisiinsa yhdistävinä rakennekomponentteina.

Mittauksen ajaksi ajoneuvo sijoitetaan oikaisupöydän päälle ja siihen kiinnikkeistä, edullisesti helmakiinnikkeistä tai vastaavista kiinnitettynä. Oikaisupöydän päälle asetetaan mittauslaitteisto ja siten, että mittauslaitteiston pitkittäisjohteet tulevat oikaisupöydän pitkittäisakseliin (X-akseli) nähden kohtisuorasti olevien oikaisupöydän poikkipalkkien päätyjen varaan.

Pitkittäisjohteita yhdistävät poikittaisjohteet tai palkit toimivat johteina niihin liittyville alapuolisille mittausyksiköille. Mittakaari, joita voi olla myös useampia,

käsittää mittausyksikön, joka on siirrettävissä mittakaaren pystypalkin johteissa eri asemiin. Mittausyksikön mittapää on siirrettävissä ulottumaan mittakaaren keskellä olevaan oikaistavaan ajoneuvoon. Mittalaitteen mittausyksikkö käsittää pitkänomaisen varren, joka on siirrettävissä haluttuun mittausasemaan ja mittalukema on luettavissa sähköisen PC-laitteen näytöltä tai manuaalisesti johteiden lukuviivojen kohdalta.

Keksinnön mukaisesti on muodostettu uudentyyppinen mittausjärjestelmä, joka perustuu sellaisen mittayksikön käyttöön, jonka mittavarren päähän on nivelöity erilliset varsiosat, joiden päätyyn liittyy mittapää. Ensimmäinen varsiosa on liikutettavissa mittavarren suhteen vaakatasossa ja toinen varsiosa on kierrettävissä pitkittäisakselinsa ympäri. Lisäksi mittapää on asennoitavissa eri lineaarisiin asemiin toisen varsiosan suhteen. Edullisesti on lisäksi toinen varsiosa liikutettavissa eri lineaariasemiin ensimmäisen varsiosan suhteen. Näin mittapäälle saadaan useita eri vapausasteita ja se voidaan viedä mittapisteteisiin myös ajoneuvon sisälle. Keksinnön mukaisesti ensimmäinen varsiosa on käännettävissä siten nivelessä mittavarren suhteen, että se lukkiutuu esimerkiksi 45° :een kulmavälein tiettyyn asemaan. Vastaava järjestelmä on toisen mittavarren kierron suhteen. Toinen mittavarsi on kierrettävissä akselinsa ympäri edullisesti 90° :een välein niin, että saadaan 90° :n välein halutut lukitusasemat. Vastaavasti mittapää on asennoitavissa eri lineaariasemiin ja lukittavissa myös haluttuun lineaariasemaan. Kyseiset varsien ja mittapään asennot asemoidaan ennakolta ja ne on ohjelmoitavissa suoraan mikroprosessorin tai tietokoneen muistiin, jolloin kutakin mittavarren asentoyhdistelmään liittyvä mittatulos saadaan suoraan tietokoneelta tai mikroprosessorilta. Tällöin voidaan tulostaa myös välittömästi mittauspöytäkirja.

Keksinnön mukaiselle mittauslaitteistolle ja menetelmälle on tunnusomaista se, mitä on esitetty patenttivaatimuksissa.

Keksintöä selostetaan seuraavassa viittaamalla oheisien piirustuksien kuvioissa esitettyihin keksinnön eräisiin edullisiin suoritusmuotoihin, joihin keksintöä ei ole tarkoitus kuitenkaan yksinomaan rajoittaa.

5 Kuviossa 1A on esitetty ajoneuvon A oikaisulaite sivukuvantona.

Kuviossa 1B on esitetty kuvion 1A mukainen oikaisulaite päältäpäin.

10 Kuviossa 2A on esitetty mittauskehikosta muodostuva mittauslaite sovitettuna oikaisupöydän päälle. Esitetty mittauslaitteen keskittäminen ajoneuvon keskilinjän mukaisesti ja kuviossa esitetysti keksinnön mukaiset tukivarret on sovitettu mittauskehikon ja ajoneuvon välille.

15 Kuviossa 2B on esitetty keksinnön mukainen laitteisto päältäpäin, jolloin neljä tukivartta on sovitettu kytkeytymään oikaistavaan ajoneuvoon.

Kuviossa 2C on esitetty leikkaus I-I kuvioista 2B.

20 Kuviossa 2D on esitetty kuvion 2C laiteratkaisu nuolen k_1 suunnasta.

Kuviossa 3A on esitetty keksinnön mukainen mittausjärjestelmä, jossa mittavarteen 40 liittyy nivelen 41 ja varsien 42 ja 43 kautta mittapää 64. Kuviossa on havainnollistettu keksinnön mukaista mittauslaiteratkaisua.

25 Kuviossa 3B on esitetty ns. hajoituskuvantona keksinnön mukainen mittauslaitteisto, joka liittyy mittavarteen.

Kuviossa 3C on esitetty holkin 44 otsapinnalla 44b olevat reiät, joihin kuula/kuulat asettuvat lukitusasennoissa.

Kuviossa 3D on esitetty varsi 42 poikkileikkauskuvantona. Esitettynä on 90°:een kulmavälillä olevat reiät, joihin kuulat lukitustilanteessa asettuvat.

~~Kuviossa 4 on havainnollistettu keksinnön mukaisella laitteistolla suoritettut~~
5 mittaukset. Mittauksia on esitetty viitenumeroin 1, 2 ... ja 5.

Kuviossa 5A - 5E on esitetty suurennetussa mittakaavassa kuviossa 4 numeroin 1 - 5 esitetyt mittauskohteet.

10 Kuviossa 1A esitetysti käsittää ajoneuvon oikaisulaite kuviossa esitetyn oikaisupöydän 10, joka on saksinosturin 13 avulla nostettavissa ja laskettavissa perusrungon 12 suhteen. Oikaisulaite käsittää sen oikaisupöydässä 10 olevat poikkipalkit 11b₁, 11b₂, 11b₃ ja 11b₄, joihin kiinnittimet 11a₁, 11a₂... on sovitettu, jolloin kiinnittimien avulla oikaistava ajoneuvo on kiinnitettävissä
15 oikaisupöytään.

Kuviossa 1B on esitetty kuvion 1A mukainen laiteratkaisu päältäpäin. Oikaisupöytä 10 käsittää pitkittäispalkit ja niihin liittyvät poikkipalkit 11b₁, 11b₂, 11b₃ ja 11b₄. Poikkipalkkeihin liittyy kiinnittimet 11a₁, 11a₂, 11a₃ ja 11a₄, joista
20 ajoneuvo on kiinnitettävissä oikaisupöytään 10 ajoneuvon oikaisun ajaksi. Oikaisu voidaan suorittaa kuviossa vetoriimuin tai vastaavin työkaluin, jolloin oikaisuvoima on esimerkiksi vetoriimulla kohdennettavissa esimerkiksi oikaisupöytään liitetyn oikaisupuomin kautta ajoneuvon oikaisukohteeseen.

25 Kuviossa 2A on esitetty mittauslaite 15 sovitettuna oikaisupöydän 10 varaan. Mittauslaite 15 käsittää pitkittäisjohteet 15a₁, 15a₂, edullisesti palkkirakenteet, jotka asetetaan ajoneuvon A pitkittäisakselin X suuntaisesti vaakasuoraan. Koh-tisuorasti pitkittäisjohteiden keskilinjoi X₁ vastaan sijaitsevat poikkijohteet 16a₁, 16a₂..., edullisesti myös palkit, joihin mittausyksiköt 17a₁, 17a₂... on asetettavis-
30 sa.

Pitkittäisjohteiden 15a₁ ja 15a₂ yhteyteen on asetettavissa mittakaari 15b (yksi tai useampi), joka käsittää pystypalkit 15b₁, 15b₂, edullisesti pystyjohteet, joissa mittaussyksikkö 17a₁, 17a₂ on sovitettu olemaan liikutettavissa pystysuunnassa. Mittauslaitteen 15-mittaussyksikkö 17a₁, 17a₂ käsittää edelleen siihen liittyvän ja sen suhteen vaakatasossa liikutettavan mittavarren 40, ja siinä mittapään 65. Mittakaari 15b käsittää pystypalkkeja eli pystyjohteita 15b₁ ja 15b₂ ylhäältä yhdistävän yhdyspalkin 15b₃. Kun mittalaitteisto 15 on keskitetty ajoneuvon A keskilinjan (O-linja) mukaisesti, on ajoneuvo mitattavissa halutuista kohdin pitkittäisjohteisiin 15a₁, 15a₂ asetetun mittakaaren 15b yhteydessä olevien mittaussyksiköiden 17a₁, 17a₂ avulla ja vastaavasti poikittaisjohteissa olevien liikutettavien mittaussyksiköiden 17a₃, 17a₄ avulla.

Kuviossa 2A esitetysti keksinnön mukaisesti on mittauslaitteiston 15 kiinnityslaite 20, edullisesti tukivarsi sovitettu oikaistavan ajoneuvon A ja mittalaitteiston 15 välille. Edullisesti on kiinnityslaitteita 20, edullisesti tukivarsirakenteita, kaksi kappaletta kummallakin puolella ajoneuvoa A. Edullisesti suoritetaan mittalaitteen tuenta ajoneuvon A edellä mainittujen tukivarsien 20 avulla siten, että yhteen poikittaispalkkiin tai johteeseen 16a₁, 16a₂ tuetaan kaksi tukivartta 20. Kummalta-kin puolelta ajoneuvoa tukeutuu ajoneuvon poikittaispalkista 16a₁, 16a₂... yksi tukivarsi 20. Edullisesti suoritetaan tuenta siten, että tukivarsi jännitetään mittalaitteen 15 poikittaispalkin 16a₁, 16a₂... ja oikaistavan ajoneuvon A välille, joka on kiinnittimistä 11a₁, 11a₂... kiinnitetty oikaisupöytään 10.

Kuviossa 2B on esitetty keksinnön mukainen laitteisto päältäpäin. Poikittaisjohteet 16a₁, 16a₂ käsittäen niissä siirrettävissä olevat mittaussyksiköt 17a₃, 17a₄ (kuviossa 2A) on sovitettu pitkittäisjohteiden 15a₁ ja 15a₂ välille. Poikittaisjohteet 16a₁ ja 16a₂ ovat ohjatut pitkittäisjohteissa 15a₁, 15a₂. Mittakaari 15b on ohjattu myös pitkittäisjohteissa 15a₁ ja 15a₂. Poikittaisjohteissa 16a₁, 16a₂ on ohjatut myös mittaussyksiköt 17a₃, 17a₄. Kuviossa esitetysti on neljä kiinnityslaitetta 20 sovitettu tukemaan mittauslaitteisto 15 sen mittauskehikko ajoneuvon A. Edullisesti mittauslaitteiston 15 ja ajoneuvon välillä on sellainen kiinnityslaite, joka

käsittää tukivarren, joka on jännitettävissä ajoneuvon A ja mittauslaitteiston 15 välille.

Kuviossa 2C on esitetty poikittaisleikkaus-I-I kuviosta 2B-pitkittäisjohteen ja
5 poikittaisjohteen kohdalta. Kuviossa 2C esitetysti poikittaisjohde 16a₁ käsittää
laakeroinnin 16b, joka pitää poikittaisjohteen 16a₁ aina kohtisuorassa pitkittäisak-
seliltaan y pitkittäisjohteiden 15a₁, 15a₂ pitkittäisakseleihin X₁ nähden. Kuviossa
2C esitetysti luetaan mittakaaren 15b asematieto käyttäen kuviossa esitettyä anturia
30, joka käsittää askelmoottorin 31 ja siihen liittyvän hammaspyörän 32, joka
10 kytkeytyy pitkittäisjohdetta pitkin sen matkalle asetettua hammastusta 33 vasten.
Kun mittauskaari 15b on alussa asemoitu ja kalibroitu tietyssä asemassa, ilmoittaa
askelmoottori 31 kalibrintikohdasta poissiirretyn matkan konverterin kautta
PC:lle ja edelleen näyttöön. Mittakaari 15b on laakeroitu pyörällä U₁ johdeuraan
U₂ johteessa 15a₁. Vastaavasti mittayksikkö 17a₁, 17a₂ käsittää anturilaitteet,
15 jotka ilmoittavat mittavarren 40 ulossyöttöaseman ja mittayksikön 17a₁ kor-
keusaseman pystyjohteessa 15b₁, 15b₂.

Kuviossa 2D on esitetty laitteisto kuvion 2C nuolen K₁ suunnasta eli päältäpäin.
Poikittaisjohde 16a₁, 16a₂... käsittää sen siltapalkkiin 16c nähden poikittaisesti sen
20 päädyissä olevan levyosan 16d, joka käsittää useita laakereita 16b, jotka ovat
sovitettu kyseiseen levyosaan 16d ja kulkemaan sen mukana pitkittäisjohteen 15a₁
pitkittäisessä johdeurassa U₃.

Kuviossa 3A on esitetty havainnollisesti keksinnön mukainen laitteisto käännettä-
25 vän varren 42 eri asennoissa. Mittavarteen 40 liittyy nivelen 41 kautta ensimmäi-
nen varsiosa 42, johon liittyy edelleen toinen varsiosa 43. Toiseen varsiosaan 43
liittyy mittapää 64. Mittapää 64 viedään kiinni mitattavaan pisteeseen. Varsiosa 42
on kuviossa esitetysti nivelen 41 avulla käännettävissä eri lukitusasemiin edullisesti
45°:een kulmajaolla oleviin eri lukitusasemiin. Vastaavasti toinen varsiosa 43 on
30 kierrettävissä pitkittäisakselinsa X₃₀ ympäri eri kulma-asemiin/lukitusasemiin.
Edullisesti kyseisiä kulma-/lukitusasemia on 90°:een kulmajaolla. Varsiosa 42 on

sovitettu kiertymään vaakatasossa. Mittavartta 40 liikutetaan nuolella S_1 esitetysti mittayksikön $17a_1$ suhteen, joka mittaa mittavarren 40 tarkan ulossyöttöaseman. Mittausyksikön $17a_1$ korkeusasema pystyjohteessa $15a_1$ mitataan myös mittayksikön $17a_1$ anturilaitteella. Lisäksi pystyjohde $15a_1$ on asetettavissa eri asemiin
5 ajoneuvon pitkittäisakselin X suhteen ajoneuvon sivulla. Kyseinen kulma-asema on mitattavissa erikseen, kuten kuvion 2C suoritusmuodossa on esitetty.

Kullekin mekanismin osalle on oma lukitusasento. Näin ollen syötettäessä tietokoneen muistiin varsiosan 42 tai sitä seuraavan toisen varsiosan 43 ja siihen liittyvän
10 mittapään 64 asemat, saadaan tietokoneen muistiin syötetyn ohjelman avulla heti laskettua mittapään kärjen asema. Näin ollen tiettyyn asentoyhdistelmään liittyvä mittatulos on suoraan luettavissa tietokoneen näytöltä ja/tai tulostettavissa tulostinlaitteen printteriltä mittauspöytäkirjana.

15 Keksinnön mukaisesti voidaan käyttää myös sellaista laiteratkaisua, jossa anturilaitteet havainnoivat kunkin osan, kuten varsiosan 42, toisen varsiosan 43 ja mittapään 64 kulloisenkin lukitusaseman ja kyseiset tiedot syötetään sähköisesti suoraan tietokoneen muistiin, joka ilmoittaa havainnoitua yhdistelmää vastaavan mittapään lukeman.

20

Kuviossa 3B on esitetty keksinnön mukaiseen mittalaitteistoon liittyvä mittavarsi 40, joka käsittää päädyssään nivelen 41. Mittavarren 40 pitkittäisakselia on merkitty X_{10} . Varsiosa 42 liittyy mittavarteen 40 nivelen 41 kautta. Varsiosa 42 on ontto rakenne ja käsittää sisätilan D, jota sulkee toisesta päädyistä kansi 42a.
25 Varsiosan 42 pitkittäisakselia on merkitty X_{20} . Varsiosa 43 liittyy ensimmäiseen varsiosaan 42. Kyseinen toinen varsiosa 43 on kierrettävissä pitkittäisakselinsa X_{30} ympäri. Mittapää 65 on vietävissä toisen varsiosan 43 läpimenoreiän 64 kautta. Näin ollen mittapään 65 päädyllä J eli lukupäällä on useita vapausasteita. Mittapää 65 on liikutettavissa lineaarisesti pitkittäisakselinsa X_{40} suunnassa, joka
30 akseli X_{40} on kohtisuorasti akseliin X_{30} nähden. Läpimenoreiän 64 geometrinen pitkittäisakseli on kohtisuorassa akseliin X_{30} nähden. Pääty J on ensinnäkin

nostettavissa ja laskettavissa mittakaaren pystyjohteissa ja siirrettävissä pitkittäis- eli vaakajohteissa eri asemiin ajoneuvon pitkittäisakselin X suhteen. Lisäksi mittavarsi 40 on liikutettavissa pitkittäisakselinsa X_{10} suunnassa eri asemiin autoa kohti ja siitä poispäin. Ensimmäinen varsiosa 42 on kierrettävissä nivelen 41 suhteen siten, että varsiosa 42 kääntyy vaakatasossa eri kulma-asemiin. Vastarun-
 5 ko 48 ja siihen liittyvä varsiosa 42 on kierrettävissä geometrisen akselin Y_1 ympäri, joka akseli Y_1 on kohtisuorassa mittavarren 40 pitkittäisakseliin X_{10} nähden. Edullisesti kulma-asemia on useita 45° :een välein. Lisäksi toinen varsiosa 43 on kierrettävissä myös edullisesti 90° :een kulmavälein pitkittäisakselinsa X_{30}
 10 ympäri. Lisäksi mittapää 65 on asennoitavissa lineaarisesti akselinsa X_{40} suunnassa eri asemiin toisen varsiosan 43 suhteen.

Nivel 41 on muodostettu holkista 44, joka käsittää onton sisätilan E. Holkin 44 päädyssä on kansi 44a, joka sulkee sisätilan E. Holkin 44 otsapinnalla 44b
 15 sijaitsevat 45° :een tai jollain muulla säännöllisellä asteluvulla reiät $45a_1$, $45a_2$, $45a_3$... Kuulat $46a_1$, $46a_2$..., joita jouset $47a_1$, $47a_2$ on sovitettu painamaan, sijaitsevat vastarungon 48 rei'issä $49a_1$, $49a_2$... Näin ollen vastarunko 48 on kierrettävissä haluttuun kulma-asentoon holkin 44 suhteen, joka holkki 44 on liitetty kiinteästi mittavarteeseen 40. Kiinnitysruuvi 50 on viety käännettävän vasta-
 20 rungon 48 reiän 48c läpi ja edelleen holkin 44 reiän 44c läpi ja näin ollen mutteri 52 puristaa vastarungon 48 holkin 44 otsapintaa 44b vasten. Kuulat $46a_1$, $46a_2$... jäävät holkin 44 otsapinnan 44b ja vastarungon 48 otsapinnan 48b väliin. Mutterin kiristystä 52 ruuviin 50 säätämällä säädetään haluttu säätövoima vastarungon 48 kiertämiseksi. Reikien $45a_1$, $45a_2$... kulmaväli määrää säätötarkkuuden. Edullisesti reikien $45a_1$, $45a_2$... kulmaväli on 45° .
 25

Ruuvit $53a_1$ ja $53a_2$ kiinnittävät varsiosan 42 vastarunkoon 48. Ruuvit $53a_1$, $53a_2$ on viety varsiosan 42 seinämän läpi ja sijaitsevat siten kannoiltaan varsiosan 42 sisätilassa D. Kansi 54 sulkee varsiosan 42 onton sisätilan D.

Ensimmäinen varsiosa 42 nivelen 41 jälkeen käsittää ensimmäiset parittaiset reiät $55a_1'$, $55a_1$...; $55a_2'$, $55a_2$..., joita parittaisia reikiä on edullisesti 90° :een kulmajaotuksella ja reiät on tehty ensimmäisen varsiosan 42 seinämän läpi. Kyseiset ensimmäiset reiät $55a_1'$, $55a_1$ sijaitsevat varsiosan 42 nivelen 41 puoleisessa päädyssä ja varsiosan 42 toisessa päädyssä sijaitsevat toiset parittaiset reiät $56a_1'$, $56a_1$; $56a_2'$, $56a_2$... myös 90° :een kulmajaotuksella. Varsiosa 42 käsittää lisäksi päädyssään kartiokkaan päätykierteen 57, johon mutteri 59 tulee kiristysholkin 58 sijaitessa mutterin 59 ja toisen varsiosan 43 välillä.

- 10 Toinen varsiosa 43 kuviossa 3B esitetysti sijoitetaan nuolella L_1 esitetysti ensimmäisen varsiosan 42 sisätilaan D siten, että toisessa varsiosan 42 päädyn rei'issä $60a_1'$, $60a_1$; $60a_2'$, $60a_2$... sijaitsevat jousi $61a_1$, $61a_2$ ja kuula $62a_1$, $62a_2$... tulevat olemaan yhteistoiminnallisia ensimmäisen varsiosan 42 reikien $55a_1'$, $55a_1$; $55a_2'$, $55a_2$... tai $56a_1'$, $56a_1$... kanssa. Jouset $61a_1$ ja $61a_2$ ja kuulat $62a_1$, $62a_2$... ovat yhteistoiminnallisia ensimmäisen varsiosan 42 jomman kumman päädyn reikien $56a_1'$, $56a_1$, $56a_2'$, $56a_2$ tai reikien $55a_1'$, $55a_1$; $55a_2'$, $55a_2$ kanssa eli ensimmäinen varsiosa on lineaariliikkeellä L_1 asetettavissa valinnaisiin pituusasemiin ensimmäisen varsiosan 42 suhteen. Kuulat $62a_1$, $62a_2$... sijaitsevat edullisesti vastakkaisilla puolilla varressa 43, rei'issään $56a_1'$, $56a_1$..., joihin
- 20 jouset $61a_1$, $61a_2$... on asetettu.

Toisen varsiosan 43 pääty käsittää edullisesti päätykappaleen 600, joka on muoviosa, joka on olakkeestaan asetettu varsinaisen metallista tehdyn varsiosan 430 päätyyn. Käyttämällä muoviosaa saadaan edulliset laakerointiominaisuudet kuulille ja voitelutarvetta ei esiinny. Holkki 600 on edullisesti liitetty sokalla 63 toisen varsiosan 43 kyseiseen metalliosuuteen 430.

Metalliosuuteen 430 toisen varsiosan 43 toisessa päädyssä on liitetty päätykappale 700, joka käsittää läpimenoreiän 64, joka on keskeisakseliltaan kohtisuorasti toisen varsiosan 43 pitkittäisakseliin X_{30} nähden ja jonka läpimenoreiän 64 kautta on viety mittapää 65. Mittapää 65 käsittää välimatkan päässä toisistaan olevat urat

66a₁, 66a₂... Rakenne käsittää edelleen päätynysän 67, jonka sisäreikään 68 kuula 69 ja jousi 70 on asetettu. Jouta puristamaan on asetettu ruuvi 71. Ruuvia 71 kiertämällä saadaan säädettyä se voima, jolla jousi 70 puristaa kuulan 69 jotain mittapään 65 uraa 66a₁ tai 66a₂... vasten. Siirtämällä mittapää 65 läpimenoreiässä 5 64, saadaan se valinnaisiin asemiin 66a₁ tai 66a₂... Suojus 72 on asetettu päätynysän 67 ympärille. Päätynysään 67 voidaan liittää edelleen tarvittaessa jatkovarsi.

Kuviossa 3C esitetysti holkin 44 otsapinnalla 44b sijaitsevat 45°:een kulmavälein 10 reiät 45a₁, 45a₂... Kuulat 46a₁, 46a₂ asettuvat lukitusasemiin reikiin 45a₁, 45a₂, 45a₃....

Keksinnön mukaisessa ratkaisussa ensimmäinen varsiosa 42 on siirrettävissä vaakatasossa mittavarren 40 suhteen nivelen 41 avulla eri lukitusasemiin, joita voi 15 olla 45°:een välein. Vastaavasti ensimmäiseen varsiosaan 42 liittyvä toinen varsiosa 43 on kierrettävissä pitkittäisakselinsa ympäri esim. 90°:een jaolla oleviin eri kulma- ja lukitusasemiin. Vastaavasti mittapää 64 on asennoitavissa lineaarisesti eri asemiin. Kyseiset asematiedot on ohjelmoitavissa suoraan tietokoneen muistiin ja muistissa olevan ohjelman avulla on geometrisesti laskettavissa tarkka 20 mittapään 65 päädyn J asema. Näin ollen kun mittavarsien 42, 43 eri asemat on ennalta ohjelmoitu tietokoneen muistiin, ilmoittaa tietokone suoraan kyseiseen mittavarsiasemayhdistelmään liittyvän mittaustuloksen tietokoneen näytöltä ja/tai kyseinen mittaustulos on suoraan tulostettavissa mittauspöytäkirjana.

25 Keksinnön mukaisesti voidaan niveleen 41 liittyvä ensimmäinen varsiosa 42 ja siihen liittyvä toinen varsiosa 43 ja siihen liittyvä mittapää 65 varustaa myös sähköisin välinein, jotka ilmoittavat varsiosan 42, 43 ja mittapään 65 asemat suoraan tietokoneelle, joka tallentaa ne tietokoneen muistiin ja ilmoittaa edelleen mittakärjen J tarkat koordinaatit kolmiulotteisessa avaruudessa. Voidaan käyttää 30 erilaisia aseman tunnistimia, jotka ilmoittavat suoraan varsiosien 42 ja 43 mittapään 64 asematiedot tietokoneelle.

Kuviossa 3D on esitetty varren 42 reiät $56a_1$, $56a_2$, joihin jouset $61a_1$, $61a_2$ painavat kuulat $62a_1$, $62a_2$... kulloisessakin lukitustilanteessa. Reiät sijaitsevat 90° :een kulmavälillä, jolloin mahdollistetaan varrelle 43 kahdeksan eri lukitusasentoa kierrettäessä sitä pitkittäisakselinsa X_{30} -ympäri. — — —

5

Kuviossa 4 on esitetty keksinnön mukaisen mittavarren 40 eri mittauskohteita korjattavan ajoneuvon yhteydessä. Mittakohteita on kuviossa esitetty viitenumeroin 1, 2, 3, 4 ja 5. Vastaavat mittapään kohdat on esitetty suurennetussa kuvannossa kuvioissa 5A, 5B, 5C, 5D, ja 5E.

10

Kuviossa 5A on meneillään katon kulmanmittaus, joka varmistaa ikkuna- ja oviaukkojen oikean mitoituksen. Kuviossa 5B on esitetty takajousituksen kiinnityspaikkojen mittaus auton sisätilassa, joka on mahdollista keksinnön mukaisella kääntyvällä mittauspäällä. Kuviossa 5C on esitetty jousituksen ylätuennan mittaus, joka on yksi tärkeimpiä mittauskohteita. Kuviossa 5D on esitetty pystypilarin mittaus, joka käsittää useasti myös takaovien kiinnityspulttien paikkojen mittauksen.

15

Kuviossa 5E on esitetty ajo-ominaisuuksiin vaikuttavan alatukivarren kiinnityspultin sijainnin mittaus.

20

Patenttivaatimukset

1. Mittauslaitteisto autonkorin oikaisutyöhön, joka mittauslaitteisto on asetettavissa oikaisupöydän (10) yhteyteen, jonka kiinnittimiin (11a₁, 11a₂, 11a₃, 11a₄) ajoneuvo kiinnitetään oikaisutyön ajaksi, ja jonka mittauslaitteiston (15) mittausyksikkö (17a₁, 17a₂) on liikutettavissa pystyjohteessa (15b₁, 15b₂), joka pystyjohteessa (15b₁, 15b₂) on liikutettavissa edelleen pitkittäisjohteessa (15a₁, 15a₂), ja johon mittausyksikköön (17a₁) on asetettavissa liikutettavissa oleva mittavarsi (40), **tunnettu** siitä, että mittavarsi (40) käsittää nivelen (41), johon ensimmäinen varsiosa (42) liittyy siten, että varsiosa (42) on kierrettävissä nivelen (41) varassa mittavarteen (40) nähden ja että varsiosaan (42) liittyy toinen varsiosa (43), joka on kierrettävissä pitkittäisakselinsa (X₃₀) ympäri, johon toiseen varsiosaan (43) liittyy mittapää (65) joko suoraan tai väliosan kautta.
- 15 2. Patenttivaatimuksen 1 mukainen mittauslaitteisto autonkorin oikaisutyössä, **tunnettu** siitä, että toinen varsiosien (42, 43) muodostama rakenne on jatkettavissa varsiosan (42) pitkittäisakselin (X₂₀) suunnassa siten, että toinen varsiosa (43) on siirrettävissä ensimmäisen varsiosan (42) suhteen eri pituusasemiin.
- 20 3. Jonkin edellä olevan patenttivaatimuksen mukainen mittauslaitteisto, **tunnettu** siitä, että toinen varsiosa (43) käsittää päädyssään läpimenoireiän (64), jonka kautta mittapää (65) on viety kohtisuorasti toisen varsiosan pitkittäisakseliin (X₃₀) nähden.
- 25 4. Jonkin edellä olevan patenttivaatimuksen mukainen mittauslaitteisto, **tunnettu** siitä, että mittavarren (40) päädyssä oleva nivel (41) muodostuu holkkiosasta (44), jonka suhteen vastarunko (48) on kierrettävissä valinnaisiin kulma-asemiin siten, että vastarunko (48) käsittää otsapinnallaan (48b) reiät (49a₁, 49a₂...) ja että sitä vasten tuleva holkki (44) käsittää otsapinnallaan (44b) reiät (45a₁, 45a₂, 45a₃), joihin kuulat (46a₁, 46a₂...) lukitusasemissa asettuvat ja että kuulat (46a₁, 46a₂) ja niitä painavat jouset (47a₁, 47a₂) on asetettu vastarungon (48) reikiin (49a₁,
- 30

49a₂...), jolloin vastarunko (48) on kierrettävissä reikäkulmavälin määräämän jaotuksen mukaan haluttuun kulma-asemaan/lukitusasemaan, ja että vastarunkoon (48) liittyvä varsiosa (42) saadaan käännettyä vaakatasossa mittavarteen (40) nähden.---

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5. Jonkin edellä olevan patenttivaatimuksen mukainen mittauslaitteisto, **tunnettu** siitä, että ensimmäinen varsiosa (42) käsittää molemmissa päädyissään reiät (55a₁, 55a₁; 55a₂, 55a₂ ... 56a₁, 56a₁; 56a₂, 56a₂ ...), jolloin toisessa varsiosassa (43) sen rei'issä (60a₁, 60a₁; 60a₂, 60a₂) olevat jouset (61a₁, 61a₂...) ja kuulat (62a₁, 62a₂) on saatettavissa valinnaisesti joko varsiosan (42) toisen pään reikiin (55a₁, 55a₁...) tai toisen pään reikiin (56a₁, 56a₁...), jolloin kuulat (62a₁, 62a₂...) on kierrettävissä halutun kulmavälin ja ne asettuvat ensimmäisen varsiosan (42) reikiin (55a₁, 55a₁... tai 56a₁, 56a₁...) lukitusasemiin valinnaisesti.

15 6. Jonkin edellä olevan patenttivaatimuksen mukainen mittauslaitteisto, **tunnettu** siitä, että toinen varsiosa (43) käsittää päätykappaleen (700) ja siinä läpimenoreiän (64) mittapäälle (65) ja että mittapää (65) käsittää urat (66a₁, 66a₂), jolloin mittapää (65) on asetettavissa valinnaisesti aseisiin päätykappaleen (700) käsittäessä päätynysän (67), jonka sisäreikään (68) kuula (69) ja jousi (70) on asetettu, jolloin 20 ruuvi (71) puristaa kuulan (69) johonkin mittapään (65) lukitusaseman määräämään uraan (66a₁ tai 66a₂...).

7. Jonkin edellä olevan patenttivaatimuksen mukainen mittauslaitteisto, **tunnettu** siitä, että toinen varsiosa (43) käsittää ensimmäisen varsiosan (42) puoleisessa 25 päädyssä päätyholkin (600), joka on kiinnitetty sokalla (63) toisen varsiosan (43) metalliosuuteen (430) ja että reiät (60a₁, 60a₁, 60a₂, 60a₂) on tehty muovista olevaan päätyholkkiin (600), jolloin mahdollistetaan hyvät laakerointiominaisuudet kuulille (62a₁, 62a₁...).

30 8. Jonkin edellä olevan patenttivaatimuksen mukainen mittauslaitteisto, **tunnettu** siitä, että ensimmäinen varsiosa (42) käsittää päädyssään päätykierteet (57), joihin

mutteri (59) on liitettävissä, jolloin mutterin (59) ja varsiosan (43) välisen kiristysholkin (58) avulla varsiosa (43) on kiinnitettävissä eri asemiin ensimmäisen varsiosan (42) suhteen kiristysholkin (58) ollessa halkaistu pitkittäissuunnassa, jolloin se toimii kiristysprikkanä mutterin (50) kiristäessä sen varsiosaa (43) vasten
5 kierteen (57) ollessa kartiokierre.

9. Menetelmä autonkorin oikaisutyössä autonkorin mittauksessa, jossa käytetään oikaisupöytään liittyvää mittalaitteistoa (15), joka käsittää auton pitkittäisakselin (X) suuntaisesti kulkevat johteet (15a₁, 15a₂) sekä pystyjohteet (15b₁, 15b₂),
10 jolloin pystyjohteet (15b₁, 15b₂) liikkuvat pitkittäisjohteissa (15a₁, 15a₂) ja käsittävät mittausyksikön (17a₁, 17a₂), joka on liikutettavissa pystyjohteissa (15b₁, 15b₂) ja että mittausyksikköön (17a₁, 17a₂) on asetettu liikutettava mittavarsi (40), jota voidaan liikuttaa vaakasuunnassa mittausyksikön (17a₁) suhteen, **tunnettu** siitä, että käytetään sellaista mittalaitteistoa, jossa mittavarren
15 (40) päädyssä on liikutettava ensimmäinen varsiosa (42), joka liikkuu vaakatasossa ja että kyseiseen vaakatasossa liikuteltavaan ja asennoitavaan varsiosaan (42) liittyy toinen varsiosa (43), joka on kierrettävissä pitkittäisakselinsa (X₃₀) ympäri ja että toiseen varsiosaan (43) liittyy mittapää (64), jolloin käyttämällä keksinnön mukaista järjestelyä saadaan mitattua samalla mittapäällä (64) myös autonkorin (A)
20 sisäpuoliset mittauskohteet.

10. Patenttivaatimuksen 9 mukainen menetelmä, **tunnettu** siitä, että menetelmässä luetaan kunkin mittavarteen (40) liittyvän varsiosan (42, 43) ja mittapään (64) lukitusasemayhdistelmä ja syötetään se tietokoneen muistiin tai kyseinen yhdistelmä havainnoidaan sähköisesti käyttämällä asema-antureita, jotka ilmoittavat
25 varsiosan (42) kääntöaseman, ensimmäiseen varsiosaan (42) liittyvän toisen varsiosan (43) kiertoaseman sekä toiseen varsiosaan (43) liittyvän mittapään (64) lineaariaseman, ja että kyseisten syötettyjen tai suoraan sähköisesti havainnoitujen tietojen perusteella ilmoitetaan tietokoneen tai vastaavan näyttöruudulta suoraan
30 mittaustulos ja/tai tulostetaan kyseinen mittaustulos mittauspöytäkirjana.

Tiivistelmä

- Keksinnön kohteena on mittauslaitteisto ja menetelmä autonkorin oikaisutyössä autonkorin mittauksessa. Mittauslaitteisto on asetettavissa oikaisupöydän (10) yhteyteen, jonka kiinnittimiin (11a₁, 11a₂, 11a₃, 11a₄) ajoneuvo kiinnitetään oikaisutyön ajaksi. Mittauslaitteisto (15) käsittää pitkittäisjohteen (15a₁, 15a₂), ja siinä liikutettavissa olevan pystyjohteen (15b₁, 15b₂), ja pystyjohteessa liikutettavissa olevan mittausyksikön (17a₁, 17a₂). Mittausyksikköön (17a₁, 17a₂) on asetettavissa liikutettavissa oleva mittavarsi (40). Mittavarsi (40) käsittää nivelen (41), johon ensimmäinen varsiosa (42) liittyy siten, että ensimmäinen varsiosa (42) on kierrettävissä nivelen (41) varassa mittavarteen (40) nähden vaakatasossa ja että ensimmäiseen varsiosaan (42) liittyy toinen varsiosa (43), joka on kierrettävissä pitkittäisakselinsa (X₃₀) ympäri, johon toiseen varsiosaan (43) liittyy mittapää (65) joko suoraan tai väliosan kautta.

(Fig. 3A)

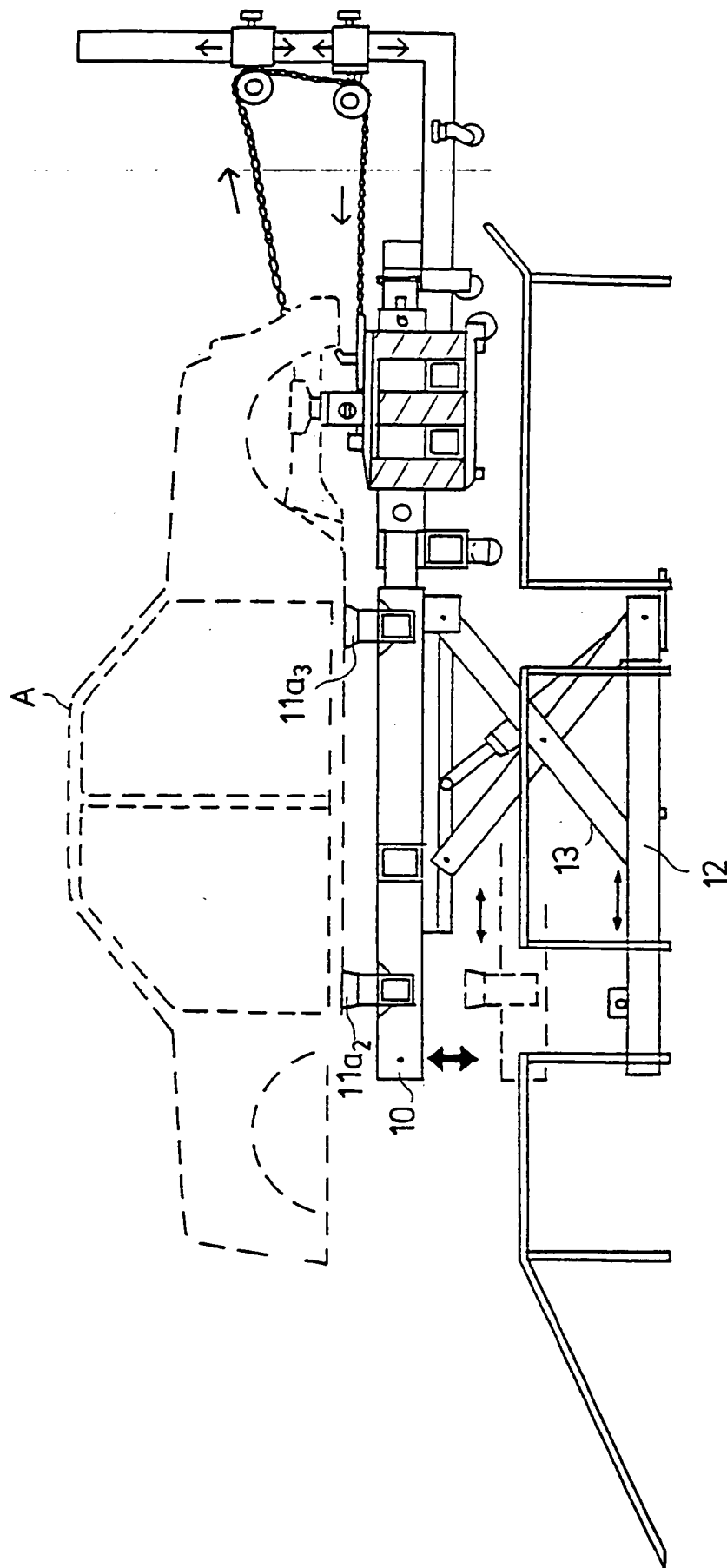


FIG. 1A

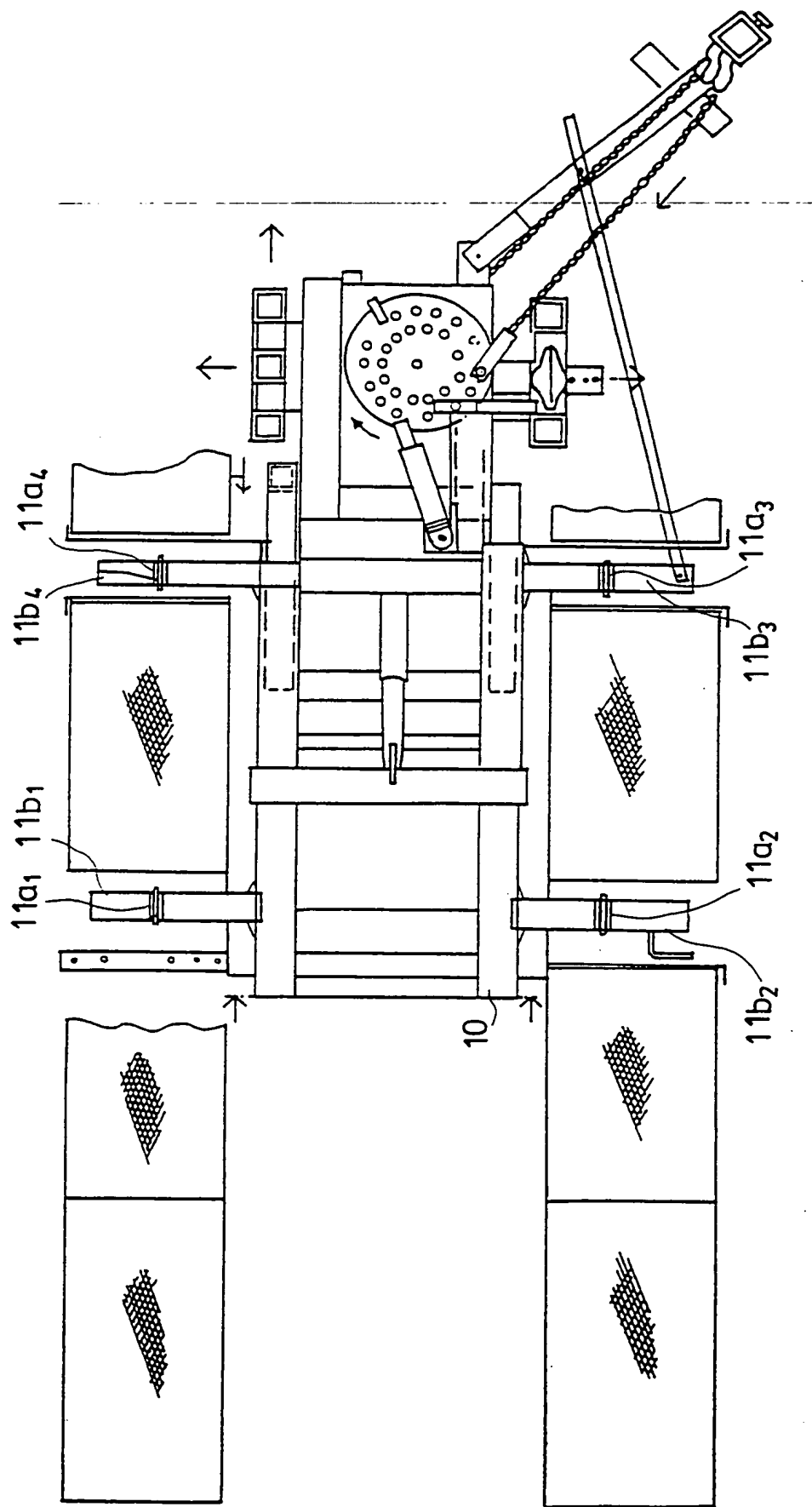


FIG. 1B

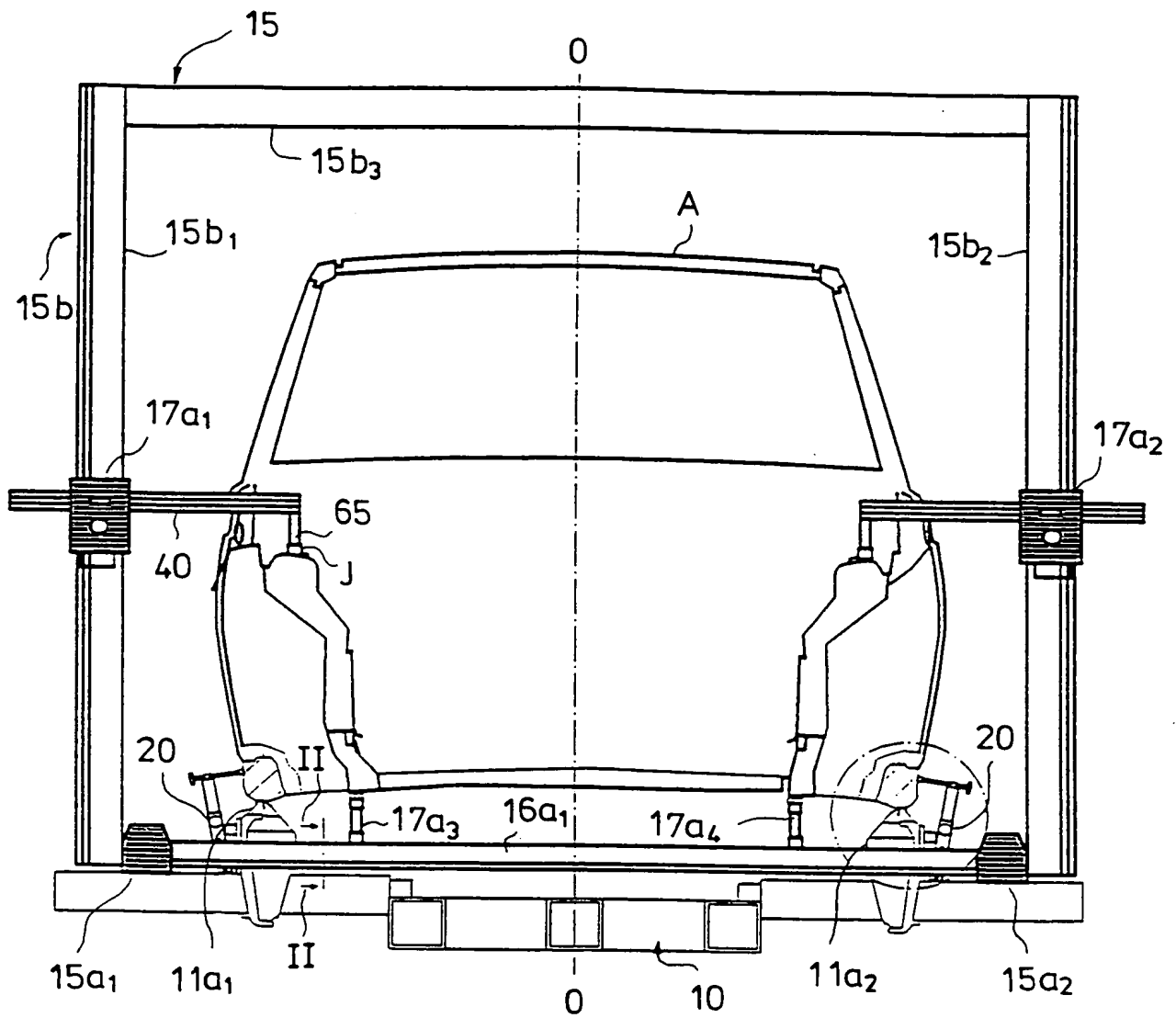


FIG. 2A



FIG. 2B

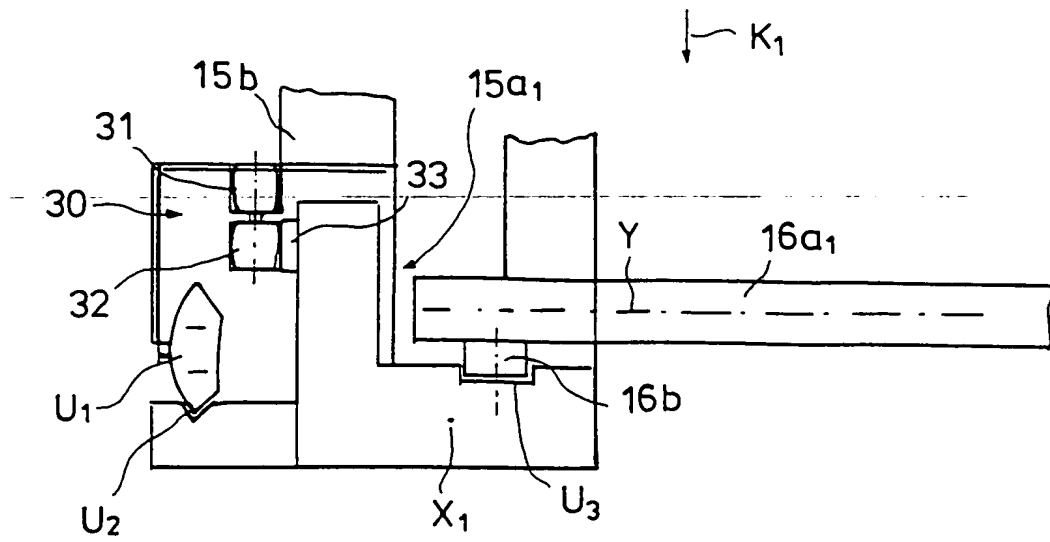


FIG. 2C

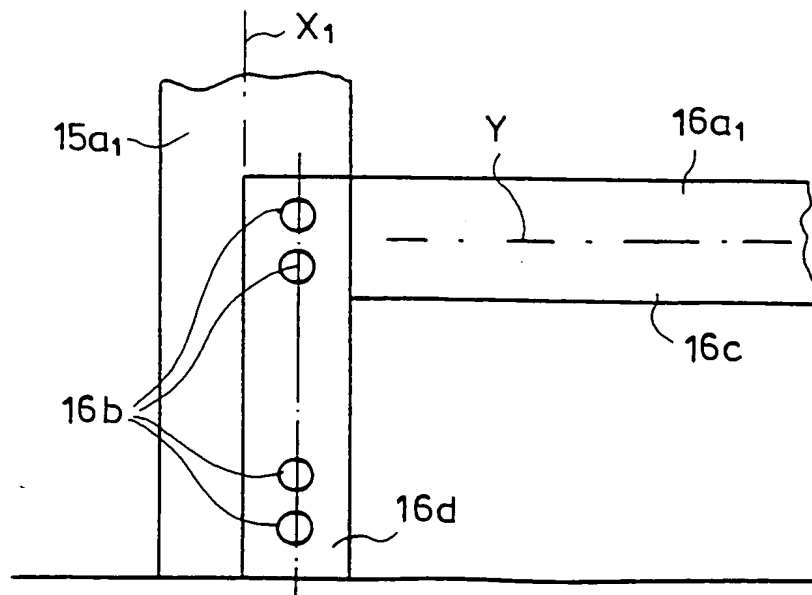


FIG. 2D

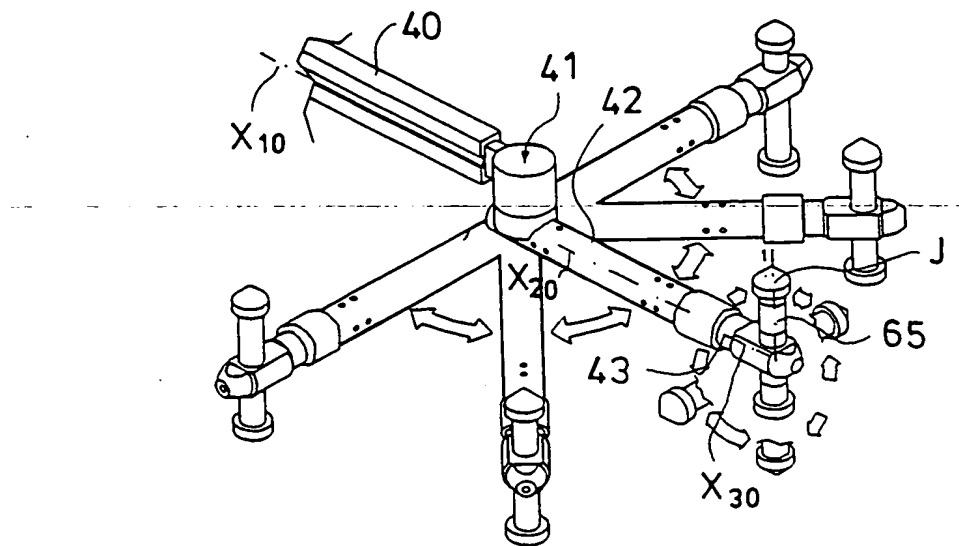


FIG. 3A

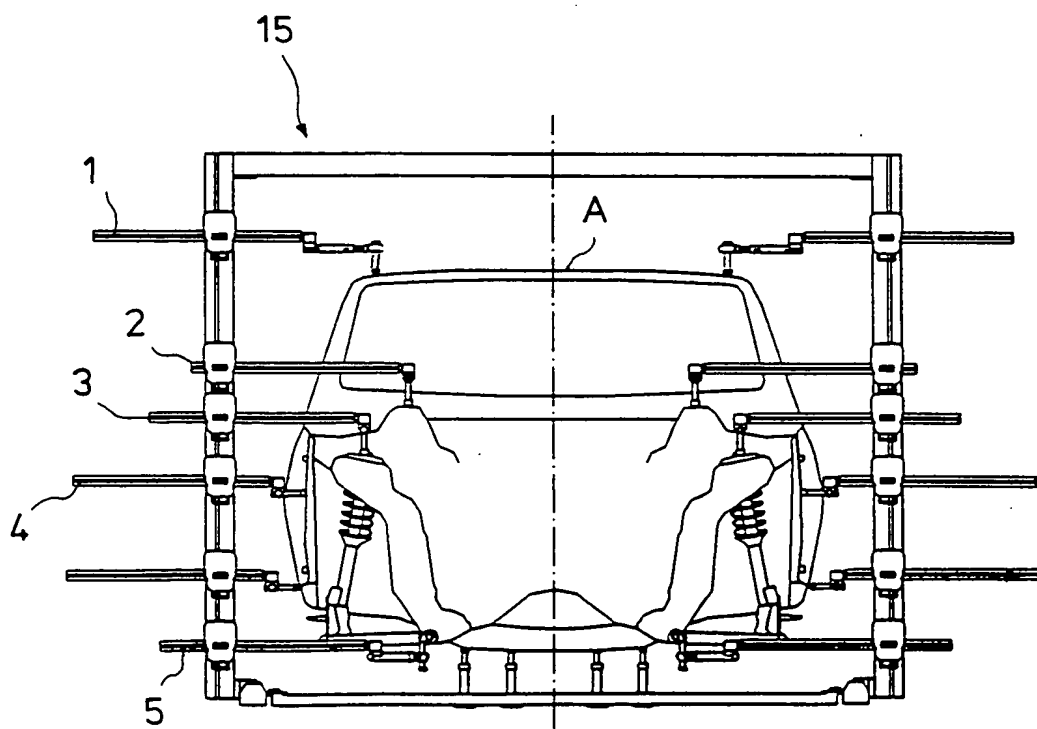
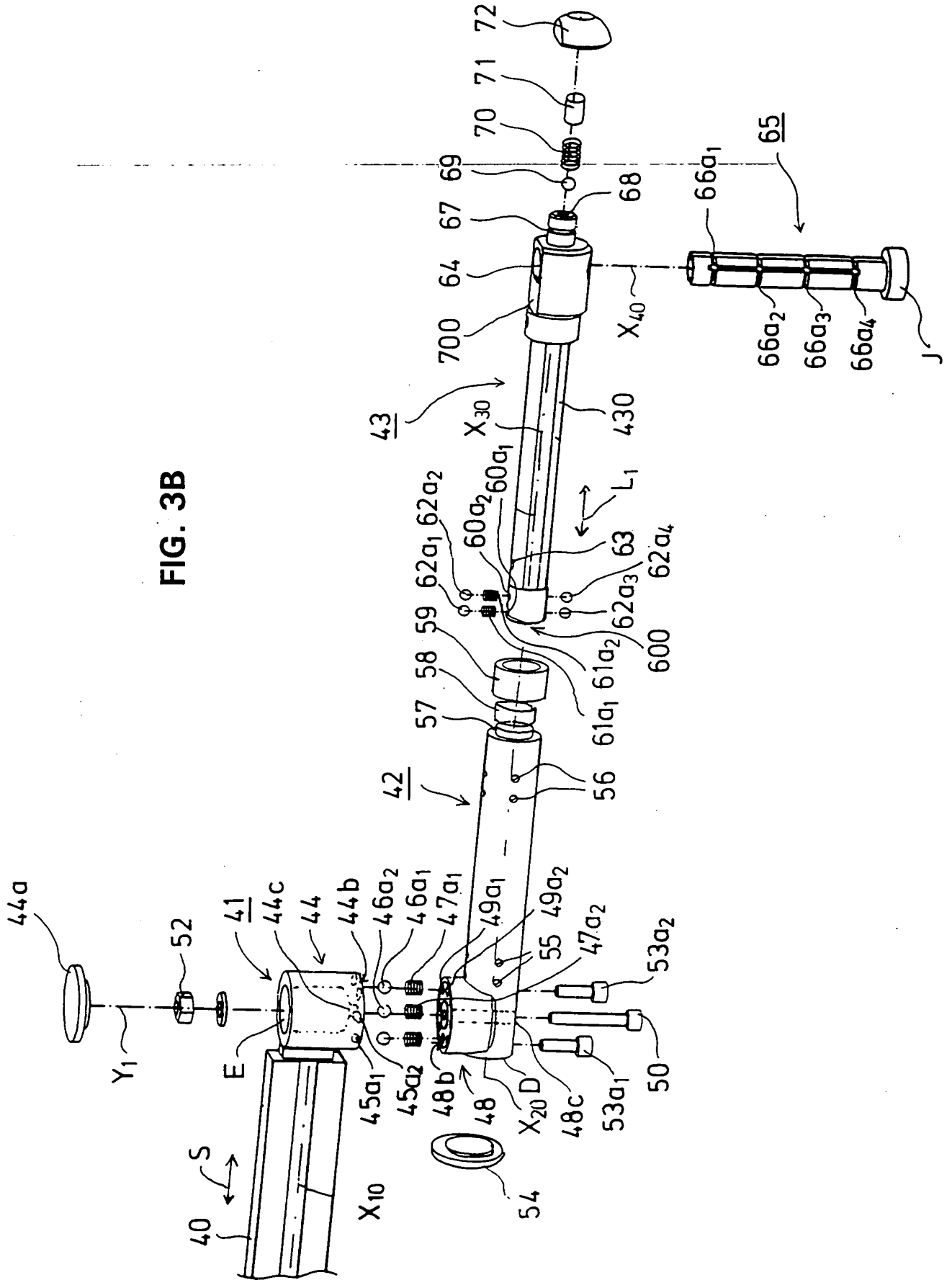


FIG. 4

FIG. 3B



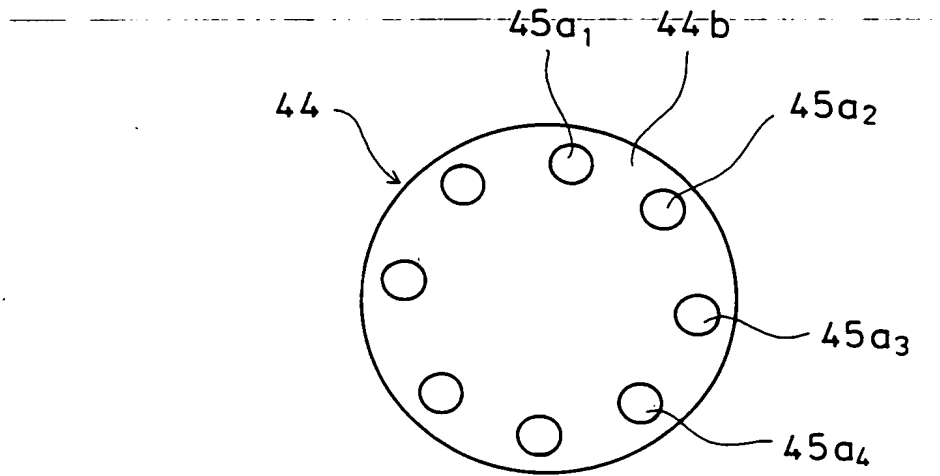


FIG. 3C

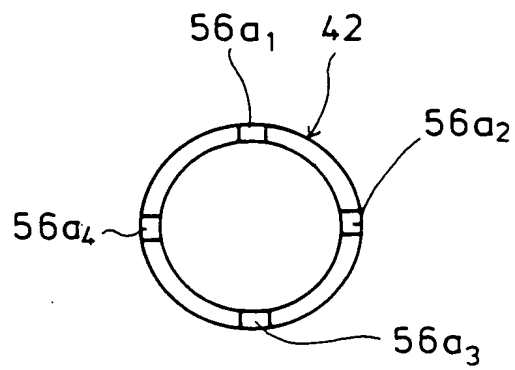


FIG. 3D

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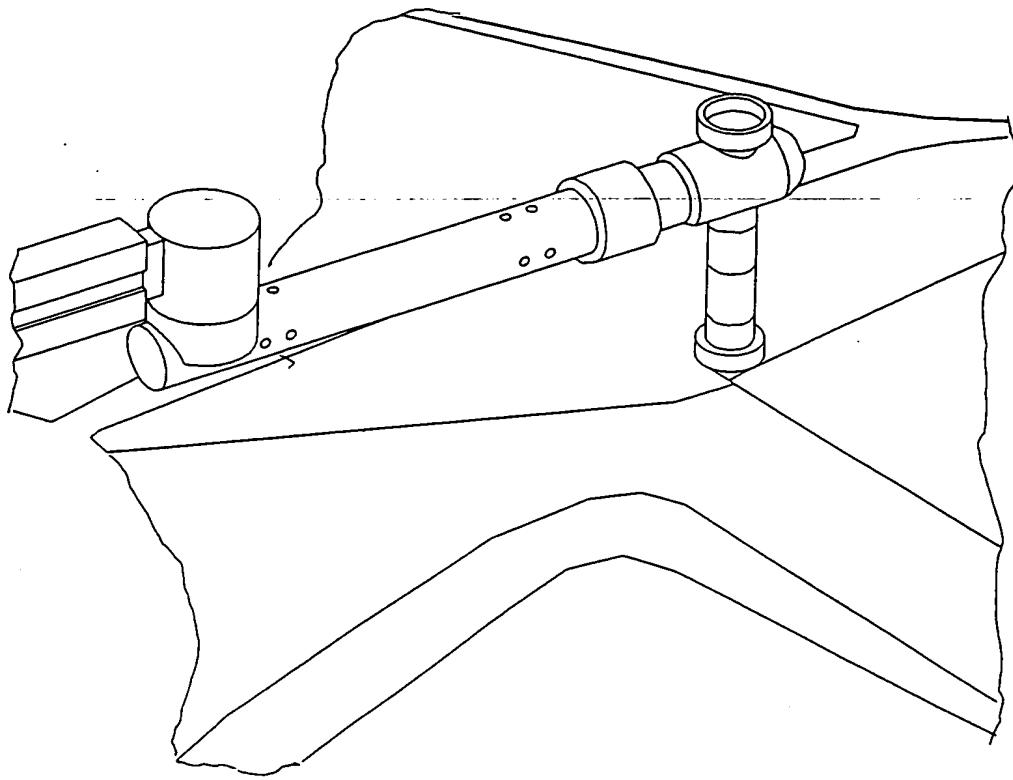


FIG. 5A

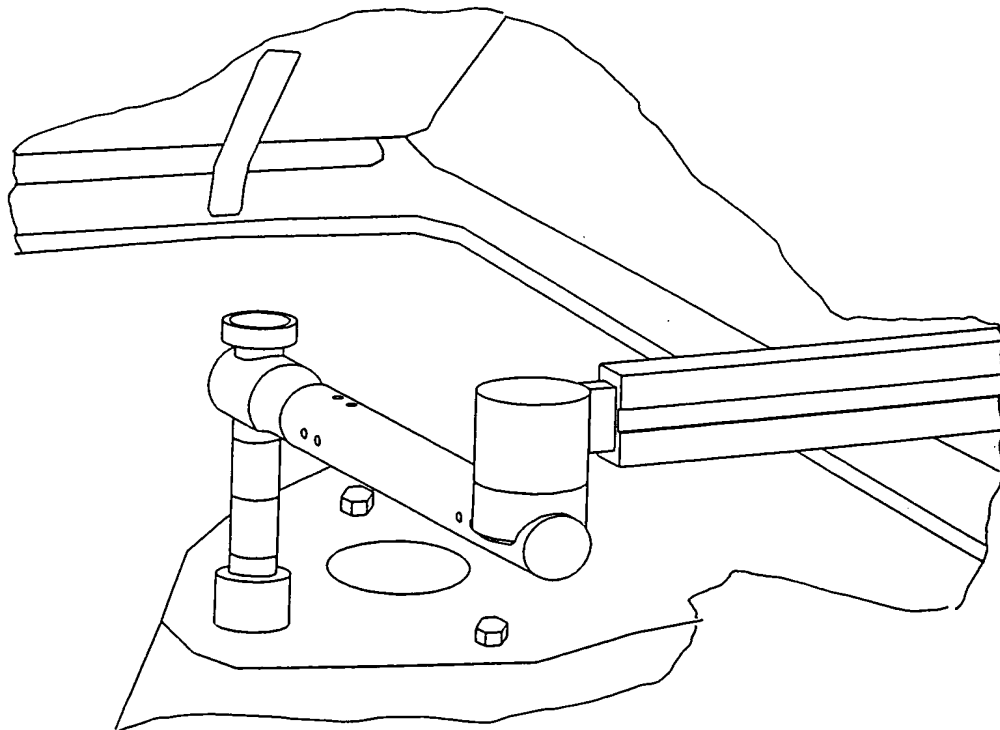


FIG. 5B

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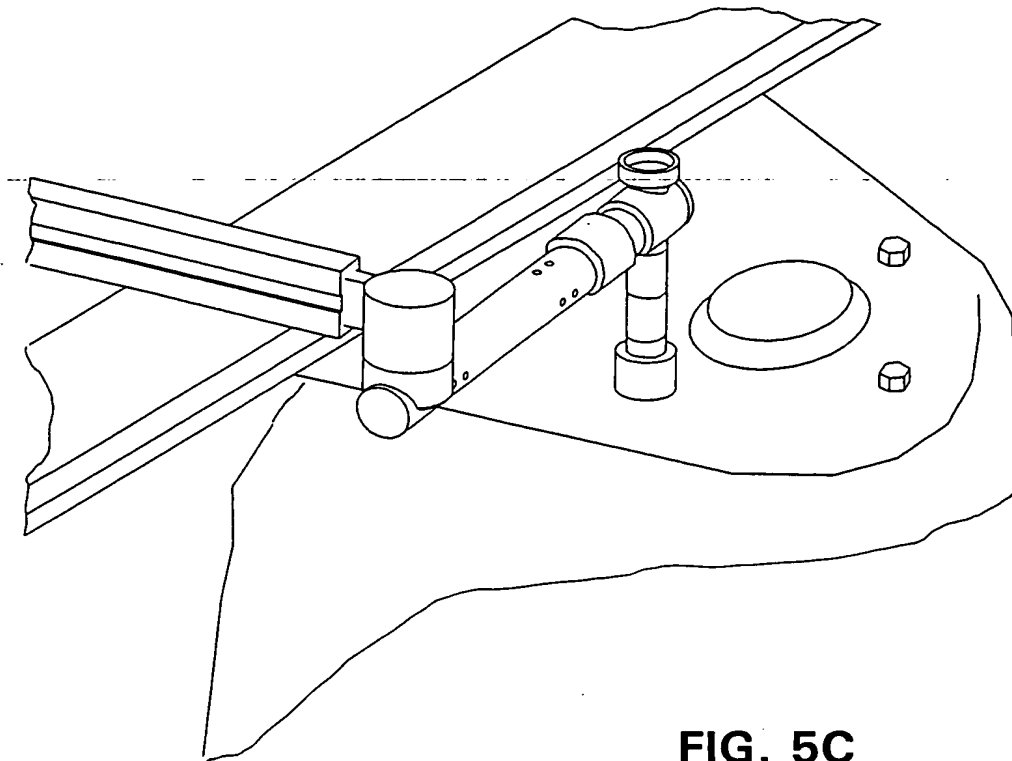


FIG. 5C

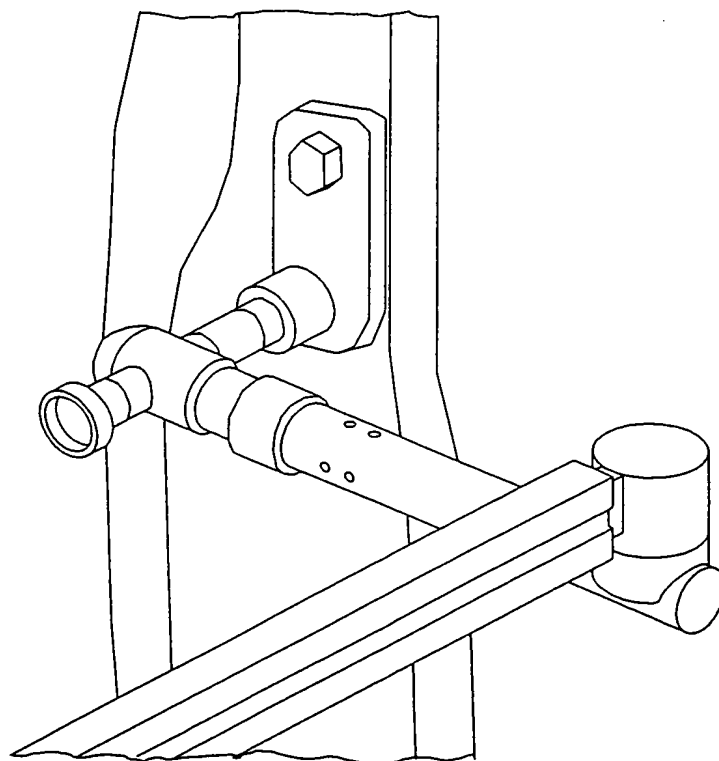
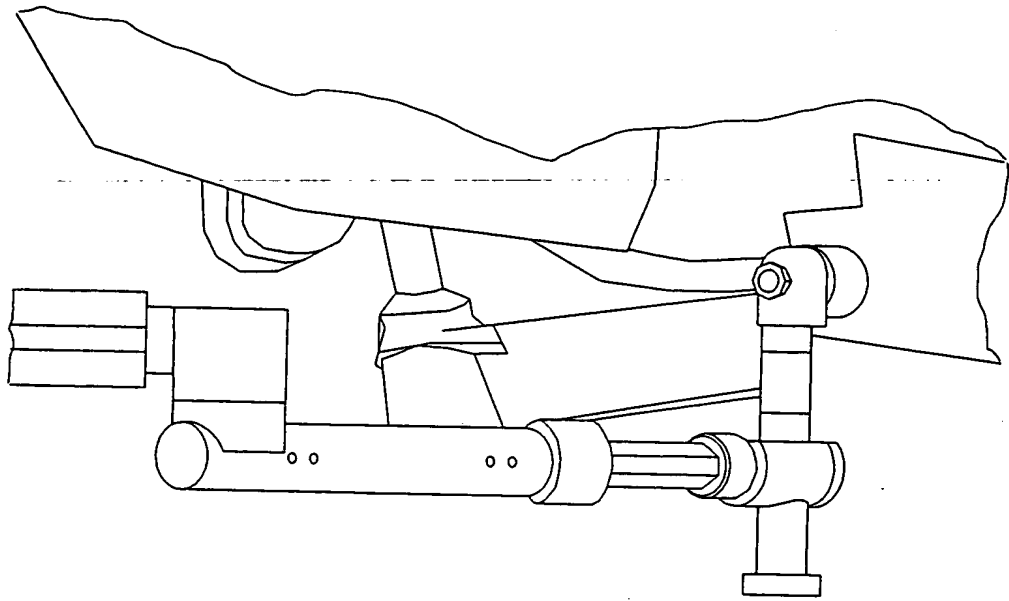


FIG. 5D

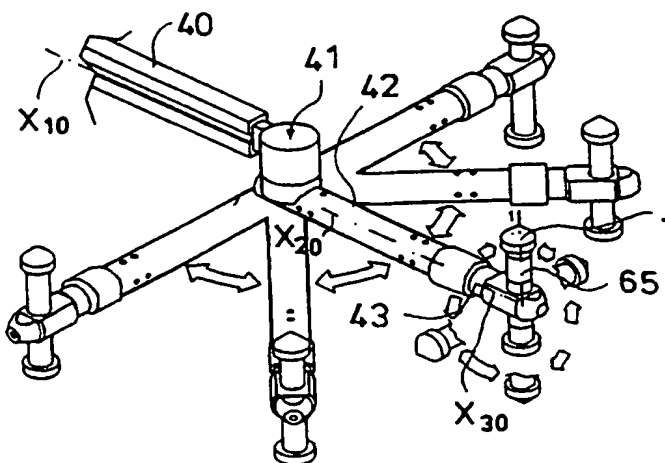
**FIG. 5E**



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(21) International Application Number: PCT/FI99/00421 (22) International Filing Date: 17 May 1999 (17.05.99) (30) Priority Data: 981125 20 May 1998 (20.05.98) FI (71) Applicant (for all designated States except US): AUTROBOT FINLAND OY [FI/FI]; Yrittäjätie 23, FIN-70150 Kuopio (FI). (72) Inventor; and (75) Inventor/Applicant (for US only): VENÄLÄINEN, Teuvo, Olavi [FI/FI]; Kiuruntie 40, FIN-70340 Kuopio (FI). (74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>In English translation (filed in Finnish).</i>

(54) Title: EQUIPMENT AND METHOD OF MEASUREMENT IN VEHICLE BODY ALIGNMENT WORK IN VEHICLE BODY MEASUREMENT

**(57) Abstract**

The invention relates to a measurement apparatus and method in vehicle body alignment work in measurement of a vehicle body. The measurement apparatus can be placed in connection with an alignment table (10) to whose fastenings (11a₁, 11a₂, 11a₃, 11a₄) the vehicle is attached for the time of the alignment work. The measurement apparatus (15) comprises a longitudinal guide (15a₁, 15a₂) and thereon a movable vertical guide (15b₁, 15b₂) and on the vertical guide a movable measurement unit (17a₁, 17a₂). A movable measurement arm (40) can be placed in the measurement unit (17a₁, 17a₂). The measurement arm (40) comprises an articulation (41) to which a first arm part (42) is connected such that the first arm part (42) can be pivoted on support of the articulation (41) in a horizontal plane with respect to the measurement arm (40), and that to the first arm part (42) is connected a second arm part (43) which can be turned around its longitudinal axis (X₃₀), to which second arm part (43) a measurement head (65) is connected either directly or through an intermediate part.

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Equipment and method of measurement in vehicle body
alignment work in vehicle body measurement

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The invention relates to a measurement apparatus and method in vehicle body alignment work in measurement of a vehicle body.

10 The apparatus arrangement in accordance with the invention comprises a device for alignment of a vehicle body, which device includes an alignment table to which a vehicle is attached by means of fastenings. The construction advantageously comprises a lifting gear, by means of which the alignment table can be raised to a desired alignment level. The tools to be coupled with the vehicle, such as pulling
15 ropes or chains, can be connected to the alignment table, preferably by means of straightening booms or equivalent. The apparatus arrangement in accordance with the invention comprises a measurement apparatus that can be fitted around the vehicle to be aligned. The measurement apparatus comprises longitudinal guides on whose support a measurement arch and the measurement units associated therewith
20 can be displaced. Perpendicularly to the centre lines X_1 of the longitudinal guides there is a transverse guide or transverse guides, which can be displaced along the longitudinal guide, having received their control from the longitudinal guide, in order to measure the constructions at the bottom of the vehicle. Said transverse guides also act as structural components interconnecting the longitudinal guides.

25

For the time of measurement, the vehicle is placed on the alignment table and attached to the table from the fastenings, preferably skirt fastenings or equivalent. Onto the alignment table, the measurement apparatus is fitted so that the longitudinal guides of the measurement apparatus are placed on support of the ends of the
30 transverse beams of the alignment table, which beams are perpendicular to the longitudinal axis (X-axis) of the alignment table.

The transverse guides or beams interconnecting the longitudinal guides operate as guides for the lower measurement units connected with them. The measurement arch, and there can also be several arches, comprises a measurement unit, which can be displaced to different positions in the guides provided on the vertical beam of the measurement arch. The measurement head of the measurement unit can be displaced so that it extends to the vehicle to be aligned, placed in the middle of the measurement arch. The measurement unit of the measurement device comprises an elongated arm, which can be displaced to a desired measurement position, and the measurement value can be read from a display of an electric PC apparatus or manually from reading bars on the guides.

In accordance with the invention, a new type of measurement arrangement has been provided which is based on the use of a measurement unit that comprises a measurement arm to whose end separate arm parts are connected by means of an articulation, a measurement head being connected to the end of said arm parts. The first arm part can be moved with respect to the measurement arm in a horizontal plane and the second arm part can be turned around its longitudinal axis. Moreover, the measurement head can be positioned in different linear positions with respect to the second arm part. Advantageously, the second arm part is also movable to different linear positions with respect to the first arm part. Thus, the measurement head is provided with several different degrees of freedom, and it can also be brought to measurement points inside a vehicle. In accordance with the invention, the first arm part can be pivoted in the articulation with respect to the measurement arm such that it is locked in a given position, for example, with an angular spacing of 45° . A similar arrangement is provided for rotating the second measurement arm. The second measurement arm can be rotated around its axis preferably with a spacing of 90° so that desired locking positions are obtained with a spacing of 90° . Similarly, the measurement head can be positioned in different linear positions and also locked in a desired linear position. Said positions of the arms and of the measurement head are set in advance and they can be programmed directly into the memory of a microprocessor or a computer, thereby allowing the measurement result associated with each combination of the measurement arm positions to be obtained directly

from the computer or the microprocessor. In that case, a measurement record can also be printed immediately.

5 Characteristic features of the measurement apparatus and method in accordance with the invention are set forth in the claims.

The invention will be described in the following with reference to some preferred embodiments of the invention illustrated in the figures of the accompanying drawings, to which embodiments the invention is, however, not intended to be exclusively
10 confined.

Figure 1A is a side view of a device for alignment of a vehicle A.

Figure 1B shows the alignment device shown in Fig. 1A viewed from above.
15

Figure 2A shows a measurement device comprising a measurement frame fitted on an alignment table. Centring of the measurement device in compliance with the centre line of the vehicle is shown, and, as shown in the figure, support arms in accordance with the invention are fitted between the measurement frame and the
20 vehicle.

Figure 2B shows the apparatus in accordance with the invention viewed from above, four support arms being arranged to be coupled with the vehicle to be aligned.

25 Figure 2C is a sectional view taken along the line I—I in Fig. 2B.

Figure 2D illustrates the apparatus arrangement shown in Fig. 2C as viewed in the direction of the arrow k_1 .

30 Figure 3A shows a measurement system in accordance with the invention in which a measurement head 64 is connected to a measurement arm 40 through an articula-

tion 41 and arms 42 and 43. The figure illustrates the measurement device arrangement in accordance with the invention.

Figure 3B is a so-called exploded view of the measurement apparatus of the invention
5 tion connected to the measurement arm.

Figure 3C shows holes situated in an end face 44b of a sleeve 44, a ball/balls being positioned in said holes in locking positions.

10 Figure 3D is a cross-sectional view of the arm 42. It shows holes situated with an angular spacing of 90° , balls being positioned in said holes in a locking situation.

Figure 4 illustrates measurements carried out by means of the apparatus in accordance with the invention. The measurements are denoted with reference numerals 1,
15 2 ... and 5.

Figures 5A—5E show on an enlarged scale the measurement points shown by numerals 1—5 in Fig. 4.

20 As shown in Fig. 1A, the vehicle alignment device comprises an alignment table 10 shown in the figure, which table can be raised and lowered by means of a scissor jack 13 with respect to a base frame 12. The alignment device comprises transverse beams $11b_1, 11b_2, 11b_3$ and $11b_4$ provided in its alignment table 10, on which beams fastenings $11a_1, 11a_2, \dots$ have been disposed, so that the vehicle to be aligned can be
25 attached to the alignment table by means of the fastenings.

Fig. 1B shows the apparatus arrangement of Fig. 1A viewed from above. The alignment table 10 comprises longitudinal beams and the transverse beams $11b_1, 11b_2, 11b_3$ and $11b_4$ connected with them. The transverse beams are provided with
30 the fastenings $11a_1, 11a_2, 11a_3$ and $11a_4$, from which the vehicle can be attached to the alignment table 10 for the time of alignment of the vehicle. The aligning can be carried out in the figure by means of pulling ropes or chains or similar tools, in

which connection the alignment force can be applied, for example, by means of the pulling rope or chain, for example, through a straightening boom connected with the alignment table, to the area to be straightened on the vehicle.

5 Fig. 2A shows a measurement device 15 as fitted on support of the alignment table 10. The measurement device 15 comprises longitudinal guides 15a₁, 15a₂, preferably beam constructions, which are placed horizontally parallel to the longitudinal axis X of the vehicle A. Perpendicularly to the centre lines X₁ of the longitudinal guides, there are transverse guides 16a₁, 16a₂..., preferably also beams, on which measurement
10 units 17a₁, 17a₂... can be placed.

In connection with the longitudinal guides 15a₁ and 15a₂, a measurement arch 15b (one or more) can be placed, which comprises vertical beams 15b₁, 15b₂, preferably vertical guides, in which the measurement unit 17a₁, 17a₂ is arranged to be movable
15 in a vertical direction. The measurement unit 17a₁, 17a₂ of the measurement device 15 further comprises a measurement arm 40 connected with said unit and displaceable with respect thereto in a horizontal plane, and a measurement head 65 in said arm. The measurement arch 15b comprises a connecting beam 15b₃ that connects the vertical beams, i.e. the vertical guides 15b₁ and 15b₂ from the top.
20 After the measurement apparatus 15 has been centred in compliance with the centre line (O-line) of the vehicle A, the vehicle can be measured at desired points by means of the measurement units 17a₁, 17a₂ situated in connection with the measurement arch 15b mounted on the longitudinal guides 15a₁, 15a₂ and, similarly, by means of the displaceable measurement units 17a₃, 17a₄ provided on the transverse
25 guides.

As shown in Fig. 2A, in accordance with the invention, a device 20 for fastening the measurement apparatus 15, preferably a support arm, is disposed between the vehicle A to be aligned and the measurement apparatus 15. Preferably, there are two
30 fastening devices 20, preferably support arm constructions, on either side of the vehicle A. Favourably, the supporting of the measurement device on the vehicle A is carried out by means of said support arms 20 such that two support arms 20 are

supported on one transverse beam or guide $16a_1, 16a_2$. On each side of the vehicle, one support arm 20 is supported on the vehicle from the transverse beam $16a_1, 16a_2$... Preferably, the supporting is carried out such that the support arm is tensioned between the transverse beam $16a_1, 16a_2$... of the measurement device 15 and the vehicle A to be straightened, which vehicle has been attached to the alignment table 10 at the fastenings $11a_1, 11a_2$...

Fig. 2B illustrates the apparatus in accordance with the invention viewed from above. The transverse guides $16a_1, 16a_2$, which comprise the displaceable measurement units $17a_3, 17a_4$ (in Fig. 2A) placed on them, are disposed between the longitudinal guides $15a_1$ and $15a_2$. The transverse guides $16a_1$ and $16a_2$ are guided in the longitudinal guides $15a_1, 15a_2$. The measurement arch 15b is also guided in the longitudinal guides $15a_1$ and $15a_2$. Also, the measurement units $17a_3, 17a_4$ are guided in the transverse guides $16a_1, 16a_2$. As shown in the figure, four fastening devices 20 are arranged to support the measurement frame of the measurement apparatus 15 on the vehicle A. Preferably, between the measurement apparatus 15 and the vehicle, there is a fastening device which comprises a support arm that can be tensioned between the vehicle A and the measurement apparatus 15.

Fig. 2C is a cross-sectional view taken along the line I—I in Fig. 2B at a longitudinal guide and a transverse guide. As shown in Fig. 2C, the transverse guide $16a_1$ comprises bearing means 16b which always keep the longitudinal axis y of the transverse guide $16a_1$ perpendicular to the longitudinal axes X_1 of the longitudinal guides $15a_1, 15a_2$. As shown in Fig. 2C, the data on the position of the measurement arch 15b are read by using a detector 30 shown in the figure, which detector comprises a stepping motor 31 and an associated cogged wheel 32, which is in engagement with teeth 33 provided along the length of the longitudinal guide. When the measurement arch 15b has been positioned and calibrated initially in a certain position, the stepping motor 31 indicates the distance of shifting apart from the calibration point through a converter to a PC and further to a display. The measurement arch 15b is mounted by means of a wheel U_1 in a guide groove U_2 in the guide $15a_1$. Similarly, the measurement unit $17a_1, 17a_2$ comprises detector means

which indicate the feed-out position of the measurement arm 40 and the height position of the measurement unit 17a₁ in the vertical guide 15b₁, 15b₂.

Fig. 2D illustrates the apparatus viewed in the direction of the arrow K₁ in Fig. 2C, i.e. from above. The transverse guide 16a₁, 16a₂... comprises a plate part 16d situated at its ends perpendicularly to its bridge beam 16c, which plate part 16d includes a number of bearings 16b, which are fitted in said plate part 16d and arranged to travel along with the plate part in a longitudinal guide groove U₃ in the longitudinal guide 15a₁.

Fig. 3A illustrates the apparatus in accordance with the invention in different positions of a pivotable arm 42. The first arm part 42 is connected to the measurement arm 40 by means of an articulation 41, a second arm part 43 being further connected to said first arm part. A measurement head 64 is connected to the second arm part 43. The measurement head 64 is brought into contact with the point to be measured. As shown in the figure, the arm part 42 can be turned by means of the articulation 41 to different locking positions, advantageously to different locking positions with an angular spacing of 45°. Similarly, the second arm part 43 can be rotated around its longitudinal axis X₃₀ to different angular positions/locking positions. Advantageously, there are such angular/locking positions with an angular spacing of 90°. The arm part 42 is arranged to pivot in a horizontal plane. The measurement arm 40 is moved as shown by the arrow S₁ with respect to the measurement unit 17a₁ which measures the exact feed-out position of the measurement arm 40. The height position of the measurement unit 17a₁ in the vertical guide 15a₁ is also measured by the detector means of the measurement unit 17a₁. Moreover, the vertical guide 15a₁ can be placed in different positions with respect to the longitudinal axis X of the vehicle on the side of the vehicle. Said angular position can be measured separately, as shown in the embodiment of Fig. 2C.

Each part of the mechanism has its own locking position. Thus, when storing in the memory of a computer the positions of the arm part 42 or the second arm part 43 following after it and of the associated measurement head 64, the position of the tip

of the measurement head can immediately be calculated by means of a program stored in the memory of the computer. Thus, the measurement result related to a given combination of positions can be read directly from a display of the computer and/or printed from a printer of an output device as a measurement record.

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In accordance with the invention, it is also possible to use a device arrangement in which detector means detect, at a given time, the locking position of each part, such as the arm part 42, the second arm part 43 and the measurement head 64, and the data in question are electrically supplied directly into the memory of the computer which indicates a reading of the measurement head corresponding to the combination detected.

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Fig. 3B shows the measurement arm 40 associated with the measurement apparatus in accordance with the invention comprising the articulation 41 at its end. The longitudinal axis of the measurement arm 40 is designated by X_{10} . The arm part 42 is connected to the measurement arm 40 through the articulation 41. The arm part 42 is a hollow structure and includes an inner space D which is closed by a cover 42a at one end. The longitudinal axis of the arm part 42 is designated by X_{20} . The arm part 43 is connected to the first arm part 42. Said second arm part 43 can be turned around its longitudinal axis X_{30} . The measurement head 65 can be passed through a through hole 64 in the second arm part 43. Thus, the tip J, or the reading head, of the measurement head 65 has several degrees of freedom. The measurement head 65 can be displaced linearly in the direction of its longitudinal axis X_{40} , which axis X_{40} is perpendicular to the axis X_{30} . The geometric longitudinal axis of the through hole 64 is perpendicular to the axis X_{30} . To begin with, the tip J can be raised and lowered in the vertical guides of the measurement arch and moved in the longitudinal or horizontal guides to different positions with respect to the longitudinal axis X of the vehicle. In addition, the measurement arm 40 can be moved in the direction of its longitudinal axis X_{10} to different positions towards and away from the vehicle. The first arm part 42 can be pivoted with respect to the articulation 41 such that the arm part 42 turns in the horizontal plane to different angular positions. A backing body 48 and the associated arm part 42 can be pivoted around a geomet-

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ric axis Y_1 , which axis Y_1 is perpendicular to the longitudinal axis X_{10} of the measurement arm 40. Advantageously, there are several angular positions with a spacing of 45° . In addition, the second arm part 43 can also be turned around its longitudinal axis X_{30} preferably with an angular spacing of 90° . Furthermore, the measurement head 65 can be positioned linearly in the direction of its axis X_{40} to different positions with respect to the second arm part 43.

The articulation 41 is formed of a sleeve 44 comprising a hollow inner space E. At the end of the sleeve 44 there is a cover 44a which closes the inner space E. On an end face 44b of the sleeve 44 there are situated holes $45a_1, 45a_2, 45a_3 \dots$ with a spacing of 45° or another regular number of degrees. Balls $46a_1, 46a_2 \dots$ which are arranged to be pressed by springs $47a_1, 47a_2$ are situated in holes $49a_1, 49a_2 \dots$ of the backing body 48. Thus, the backing body 48 can be pivoted to a desired angular position with respect to the sleeve 44, which sleeve 44 is firmly attached to the measurement arm 40. A fixing bolt 50 is passed through a hole 48c provided in the pivotable backing body 48 and further through a hole 44c of the sleeve 44, and thus a nut 52 presses the backing body 48 against the end face 44b of the sleeve 44. The balls $46a_1, 46a_2 \dots$ remain between the end face 44b of the sleeve 44 and an end face 48b of the backing body 48. The desired adjustment force for pivoting the backing body 48 is regulated by adjusting the tension of the nut 52 with the screw 50. The angular spacing of the holes $45a_1, 45a_2 \dots$ determines the accuracy of adjustment. Advantageously, the angular spacing of the holes $45a_1, 45a_2 \dots$ is 45° .

Screws $53a_1$ and $53a_2$ fasten the arm part 42 to the backing body 48. The screws $53a_1, 53a_2$ are passed through the wall of the arm part 42 and their heads are thus situated in the inner space D of the arm part 42. The cover 54 closes the hollow inner space D of the arm part 42.

The first arm part 42 after the articulation 41 comprises first holes $55a'_1, 55a_1 \dots; 55a'_2, 55a_2 \dots$ in pairs, which holes in pairs are preferably provided with an angular spacing of 90° , and the holes have been made through the wall of the first arm part 42. Said first holes $55a'_1, 55a_1$ are situated at the end of the arm part 42 on the side

of the articulation 41, and second holes $56a_1', 56a_1$; $56a_2', 56a_2$... in pairs, also with an angular spacing of 90° , are situated at the other end of the arm part 42. The arm part 42 additionally comprises at its end a tapering end thread 57 with a nut 59 placed onto it, a tension sleeve 58 being situated between the nut 59 and the second
5 arm part 43.

As shown in Fig. 3B, the second arm part 43 is placed in the inner space D of the first arm part 42 as shown by the arrow L_1 such that springs $61a_1, 61a_2$ and balls $62a_1, 62a_2$... situated in holes $60a_1', 60a_1; 60a_2', 60a_2$... at the end of the second arm
10 part 42 will be cooperative with the holes $55a_1', 55a_1; 55a_2', 55a_2$... or $56a_1', 56a_1$... of the first arm part 42. The springs $61a_1$ and $61a_2$ and the balls $62a_1, 62a_2$... are cooperative with the holes $56a_1', 56a_1, 56a_2', 56a_2$ or with the holes $55a_1', 55a_1; 55a_2', 55a_2$ at either end of the first arm part 42, i.e. the first arm part can be placed by a linear movement L_1 to alternative length positions with respect to the first arm part
15 42. The balls $62a_1, 62a_2$... are preferably situated on the opposite sides of the arm 43, in their holes $56a_1', 56a_1$..., into which the springs $61a_1, 61a_2$... are placed.

The end of the second arm part 43 advantageously includes an end piece 600, which is a plastic part placed at its shoulder to the end of an arm part 430 proper which is
20 made of metal. By using a plastic part, advantageous bearing properties are imparted to the balls, and there is no need for lubrication. The sleeve 600 is preferably attached by a cotter 63 to said metal portion 430 of the second arm part 43.

An end piece 700 is connected to the metal portion 430 at the other end of the
25 second arm part 43, said end piece 700 comprising a through hole 64 whose centre axis is perpendicular to the longitudinal axis X_{30} of the second arm part 43 and through which through hole 64 the measurement head 65 is passed. The measurement head 65 comprises grooves $66a_1, 66a_2$... in spaced relationship with one another. Further, the structure comprises an end stub 67 into whose inner hole 68 a
30 ball 69 and a spring 70 are placed. A screw 71 is arranged to press the spring. The force by which the spring 70 presses the ball 69 against one of the grooves $66a_1$ or $66a_2$... in the measurement head 65 can be regulated by turning the screw 71. By

displacing the measurement head 65 in the through hole 64, the measurement head can be brought to alternative positions 66a₁ or 66a₂... A protective cover 72 is provided around the end stub 67. When needed, an extension arm can also be attached to the end stub 67.

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As shown in Fig. 3C, the holes 45a₁, 45a₂... are situated with a angular spacing of 45° on the end face 44b of the sleeve 44. The balls 46a₁, 46a₂ are positioned in the holes 45a₁, 45a₂, 45a₃... in a locking situation.

10 In the arrangement in accordance with the invention, the first arm part 42 can be displaced in a horizontal plane with respect to the measurement arm 40 by means of the articulation 41 to different locking positions which may be provided with a spacing of 45°. Similarly, the second arm part 43 connected to the first arm part 42 can be turned around its longitudinal axis to different angular and locking positions
15 provided, for instance, with a spacing of 90°. Similarly, the measurement head 64 can be positioned linearly in different positions. Said position data can be programmed directly into the memory of a computer, and the precise position of the tip J of the measurement head 65 can be calculated geometrically by means of a program stored in the memory. Thus, when the different positions of the measurement arms 42, 43 have been preprogrammed into the memory of the computer, the
20 computer directly shows the measurement result related to said combination of the measurement arm positions on the display of the computer, and/or said measurement result can be printed directly as a measurement record.

25 In accordance with the invention, the first arm part 42 associated with the articulation 41 and the second arm part 43 connected to the first arm part as well as the measurement head 65 connected to the second arm part can also be provided with electrical means which indicate the positions of the arm parts 42, 43 and the measurement head 65 directly to a computer, which stores them in the memory of the
30 computer and further indicates the exact coordinates of the measurement tip J in three-dimensional space. Different position detectors may be used for indicating the

data on the position of the measurement head 64 of the arm parts 42 and 43 directly to the computer.

Fig. 3D shows the holes $56a_1, 56a_2$ of the arm 42 into which the balls $62a_1, 62a_2 \dots$ are pressed by the springs $61a_1, 61a_2$ in any given locking situation. The holes are provided with an angular spacing of 90° , thereby enabling the arm 43 to have eight different locking positions when turning it around its longitudinal axis X_{30} .

Fig. 4 shows different measurement points of the measurement arm 40 in accordance with the invention in connection with a vehicle to be repaired. The measurement points are denoted with reference numerals 1,2,3,4 and 5 in the figure. Figs. 5A, 5B,5C,5D, and 5E are enlarged views of the corresponding points of the measurement head.

Fig. 5A shows angular measurement of a roof going on to ensure the correct dimensioning of window and door openings. Fig. 5B shows measurement of the attachment points for rear suspension in the interior of a car, which is made possible by the turning measurement head in accordance with the invention. Fig. 5C shows measurement of the upper end of suspension, which is one of the most important measurement points. Fig. 5D shows measurement of a vertical pillar, which often also includes measurement of the locations of bolts for fastening rear doors.

Fig. 5E shows measurement of the location of a bolt for fastening a lower support arm which affects the driving characteristics.

Claims

1. A measurement apparatus for vehicle body alignment work, which measurement apparatus can be placed in connection with an alignment table (10) to whose fastenings (11a₁, 11a₂, 11a₃, 11a₄) the vehicle is attached for the time of the alignment work, and a measurement unit (17a₁, 17a₂) of which measurement apparatus (15) can be moved in a vertical guide (15b₁, 15b₂), which vertical guide (15b₁, 15b₂) can further be moved in a longitudinal guide (15a₁, 15a₂), and which measurement unit (17a₁) can be provided with a movable measurement arm (40), **characterized** in that the measurement arm (40) comprises an articulation (41) to which a first arm part (42) is connected such that the arm part (42) can be pivoted on support of the articulation (41) with respect to the measurement arm (40), and that to the arm part (42) is connected a second arm part (43) which can be turned around its longitudinal axis (X₃₀), to which second arm part (43) a measurement head (65) is connected either directly or through an intermediate part.
2. A measurement apparatus for vehicle body alignment work as claimed in claim 1, **characterized** in that a second structure formed by the arm parts (42, 43) can be extended in the direction of the longitudinal axis (X₂₀) of the arm part (42) such that the second arm part (43) can be displaced with respect to the first arm part (42) to different length positions.
3. A measurement apparatus as claimed in any one of the preceding claims, **characterized** in that the second arm part (43) comprises at its end a through hole (64) through which the measurement head (65) is passed perpendicularly to the longitudinal axis (X₃₀) of the second arm part.
4. A measurement apparatus as claimed in any one of the preceding claims, **characterized** in that the articulation (41) at the end of the measurement arm (40) comprises a sleeve part (44), a backing body (48) being pivotable with respect to the sleeve part (44) to alternative angular positions such that the backing body (48) comprises at its end face (48b) holes (49a₁, 49a₂...), and that the sleeve (44) placed

against it comprises at its end face (44b) holes (45a₁, 45a₂, 45a₃), into which balls (46a₁, 46a₂...) are positioned in locking positions, and that the balls (46a₁, 46a₂) and springs (47a₁, 47a₂) pressing the balls are placed into the holes (49a₁, 49a₂...) of the backing body (48), the backing body (48) being pivotable to a desired angular position/locking position according to the spacing determined by the angular distance
5 between the holes, and that the arm part (42) associated with the backing body (48) can be turned in a horizontal plane with respect to the measurement arm (40).

5. A measurement apparatus as claimed in any one of the preceding claims, **characterized** in that the first arm part (42) comprises at its both ends holes (55a₁', 55a₁; 55a₂', 55a₂... 56a₁', 56a₁; 56a₂', 56a₂ ...), in which connection springs (61a₁, 61a₂...) and balls (62a₁, 62a₂) situated in holes (60a₁', 60a₁; 60a₂', 60a₂) of the second arm part (43) can be brought alternatively either into the holes (55a₁', 55a₁...) of one end of the arm part (42) or into the holes (56a₁', 56a₁...) of the other end thereof, in which
15 connection the balls (62a₁, 62a₂...) can be turned through a desired angular spacing and they will be positioned alternatively in the holes (55a₁', 55a₁... or 56a₁', 56a₁...) of the first arm part (42) in locking positions.

6. A measurement apparatus as claimed in any one of the preceding claims, **characterized** in that the second arm part (43) comprises an end piece (700) and therein a through hole (64) for the measurement head (65), and that the measurement head (65) comprises grooves (66a₁, 66a₂), in which connection the measurement head (65) can be placed in alternative positions, the end piece (700) comprising an end stub (67) into whose inner hole (68) a ball (69) and a spring (70) are placed, a screw (71)
25 pressing the ball (69) into one of the grooves (66a₁ or 66a₂...) defined by the locking position of the measurement head (65).

7. A measurement apparatus as claimed in any one of the preceding claims, **characterized** in that the second arm part (43) comprises an end sleeve (600) at the end on the side of the first arm part (42), which end sleeve is attached by means of a cotter (63) to a metal portion (430) of the second arm part (43), and that the holes (60a₁,
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60a₁, 60a₂, 60a₂') have been made into the end sleeve (600) made of plastic, thereby enabling good bearing properties for the balls (62a₁, 62a₁'...).

8. A measurement apparatus as claimed in any one of the preceding claims, **characterized** in that the first arm part (42) comprises end threads (57) at its end, onto which threads a nut (59) can be mounted, so that by means of a tension sleeve (58) situated between the nut (59) and the arm part (43) the arm part (43) can be locked to different positions with respect to the first arm part (42), the tension sleeve (58) being split in a longitudinal direction, thereby serving as a tension washer when the nut (50) tightens it against the arm part (43), the thread (57) being a taper thread.

9. A method in vehicle body alignment work in measurement of a vehicle body, which method employs a measurement apparatus (15) which is connected to an alignment table and which comprises guides (15a₁, 15a₂) extending parallel to the longitudinal axis (X) of the vehicle as well as vertical guides (15b₁, 15b₂), the vertical guides (15b₁, 15b₂) moving in the longitudinal guides (15a₁, 15a₂) and comprising a measurement unit (17a₁, 17a₂) which can be moved in the vertical guides (15b₁, 15b₂), and that the measurement unit (17a₁, 17a₂) is provided with a movable measurement arm (40) which can be moved in a horizontal direction with respect to the measurement unit (17a₁), **characterized** in that the measurement apparatus used is such that it comprises at the end of the measurement arm (40) a movable first arm part (42) which moves in a horizontal plane, and that a second arm part (43) is connected to said arm part (42) which can be moved and positioned in a horizontal plane, said second arm part (43) being rotatable around its longitudinal axis (X₃₀), and that a measurement head (64) is connected to the second arm part (43), whereby, by using the arrangement in accordance with the invention, the measurement locations situated inside the vehicle body (A) can also be measured by the same measurement head (64).

10. A method as claimed in claim 9, **characterized** in that, in the method, the combination of locking positions of each arm part (42, 43) and the measurement head (64) connected to the measurement arm (40) is read and fed into the memory of a

computer or said combination is detected electrically by using position detectors which indicate the pivot position of the arm part (42), the rotation position of the second arm part (43) connected to the first arm part (42) and the linear position of the measurement head (64) connected to the second arm part (43), and that, based
5 on said data fed or directly electrically detected, the result of measurement is directly indicated on the display of the computer or equivalent and/or said measurement result is printed as a measurement record.

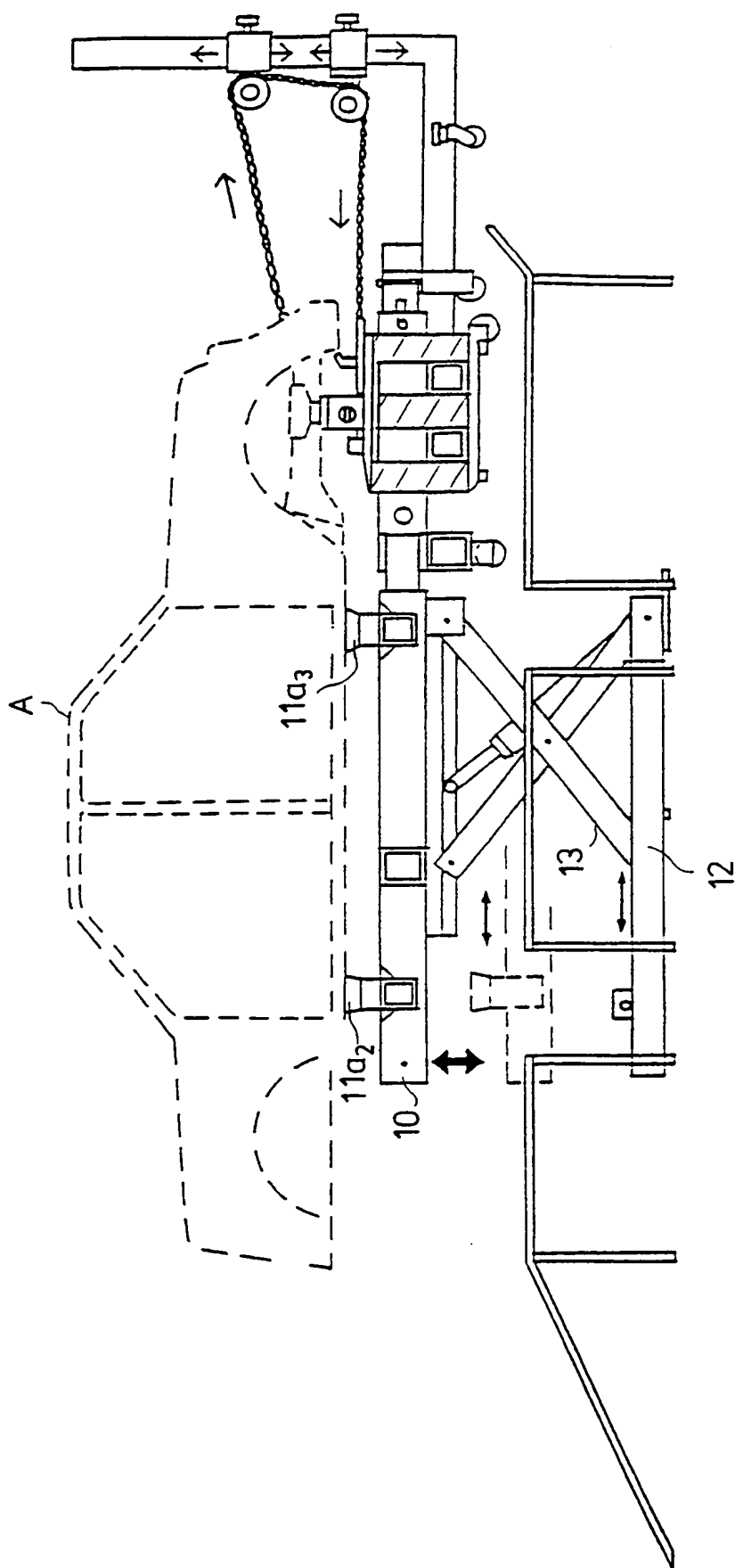


FIG. 1A

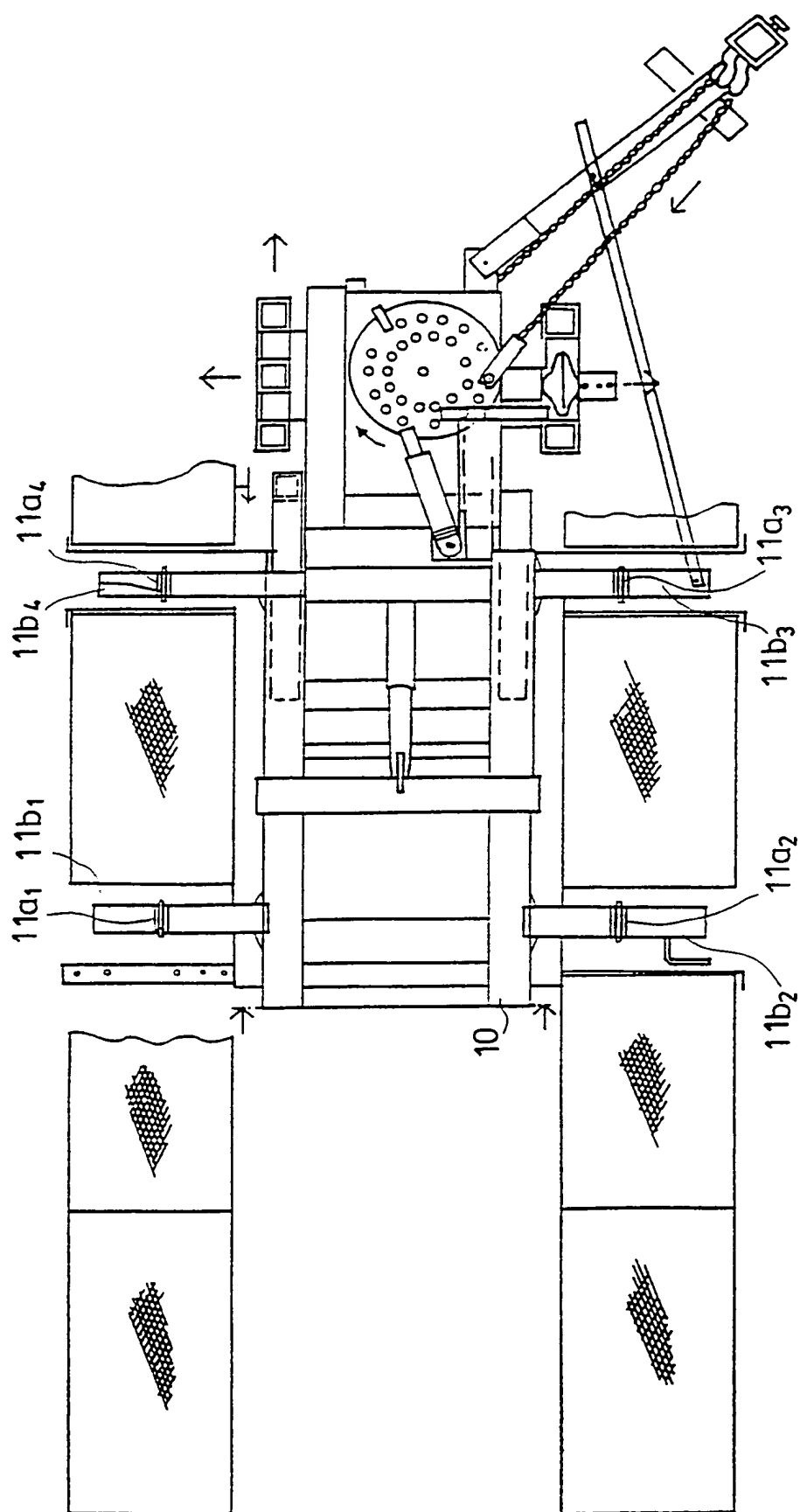


FIG. 1B

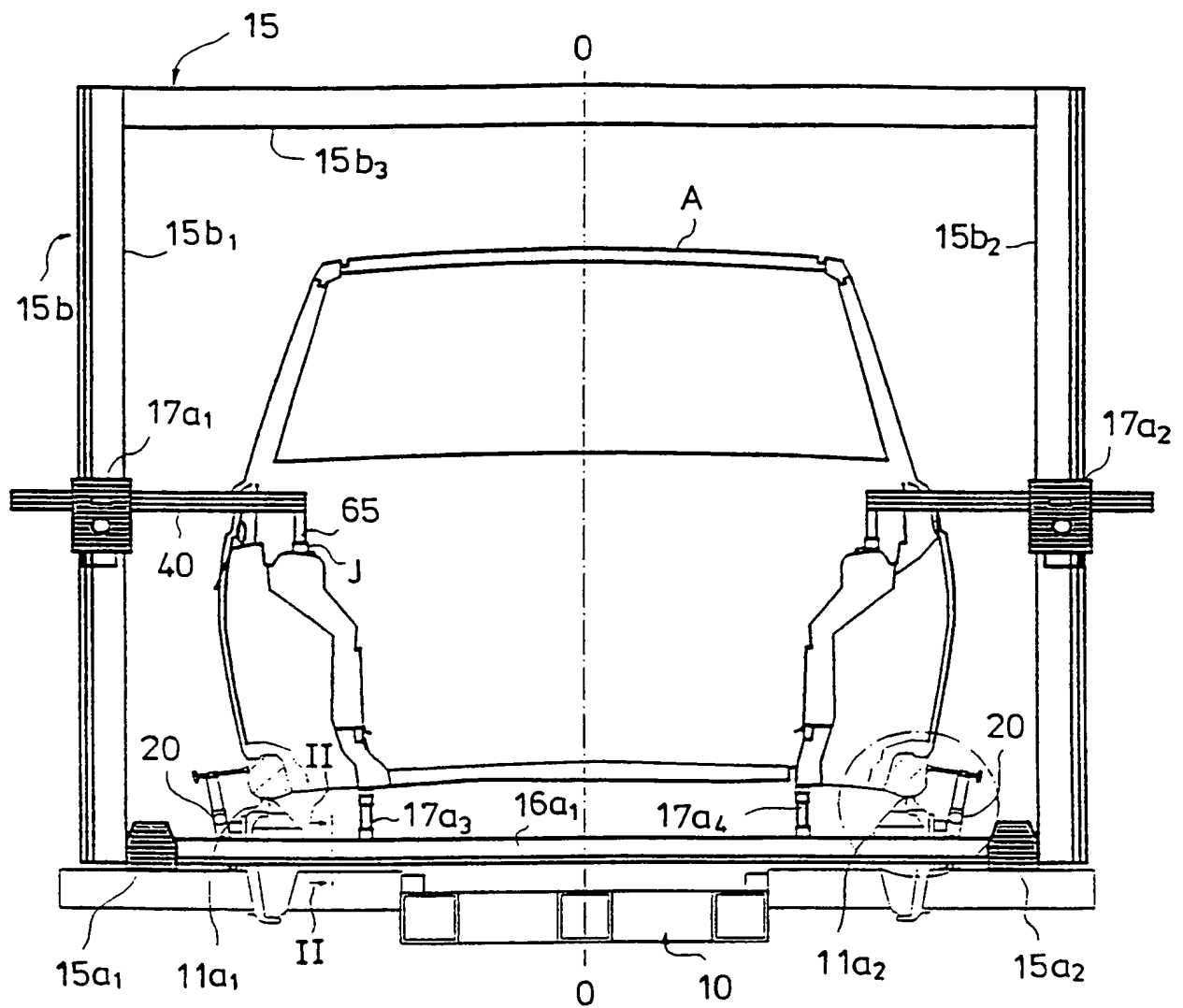


FIG. 2A

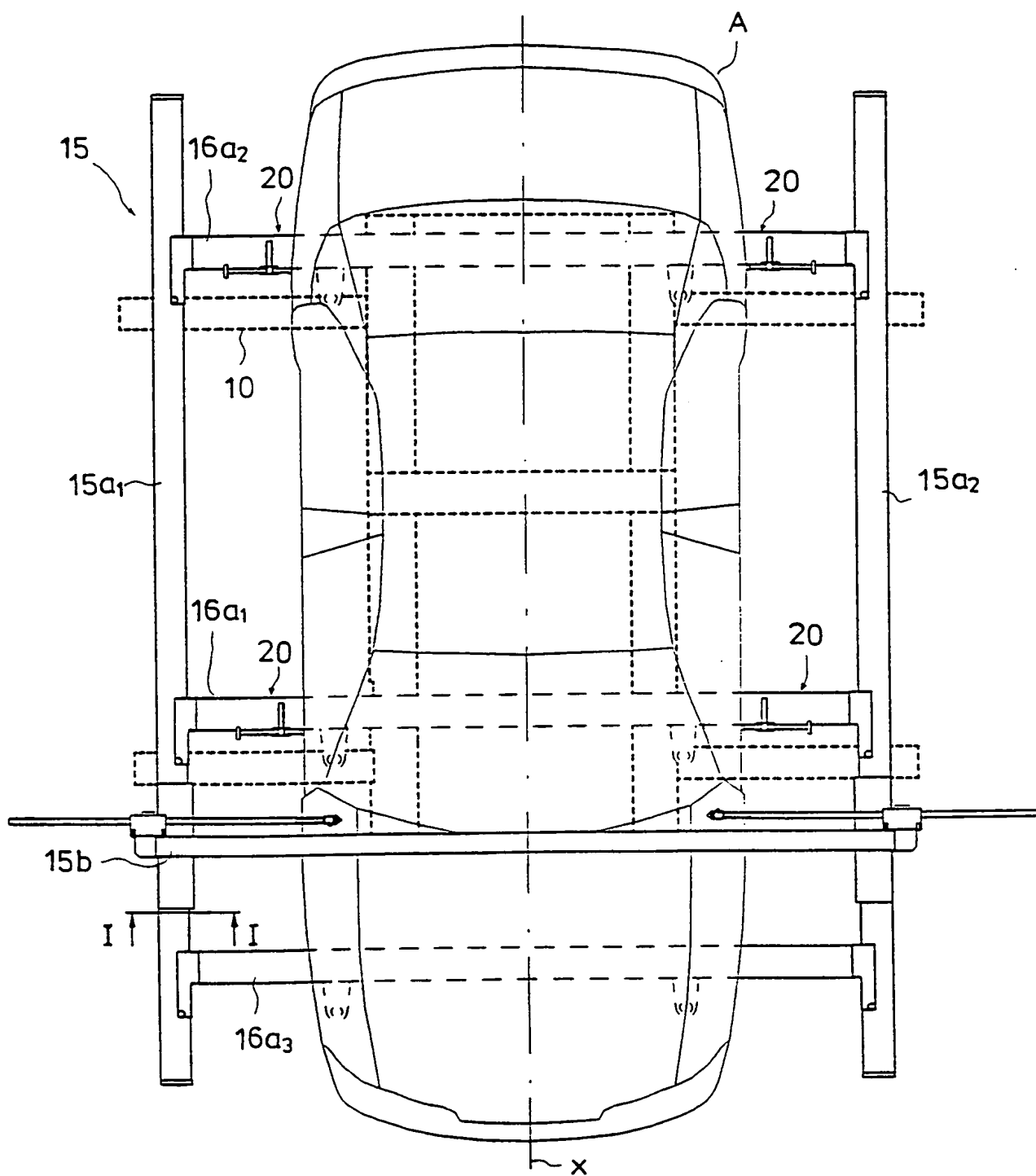


FIG. 2B

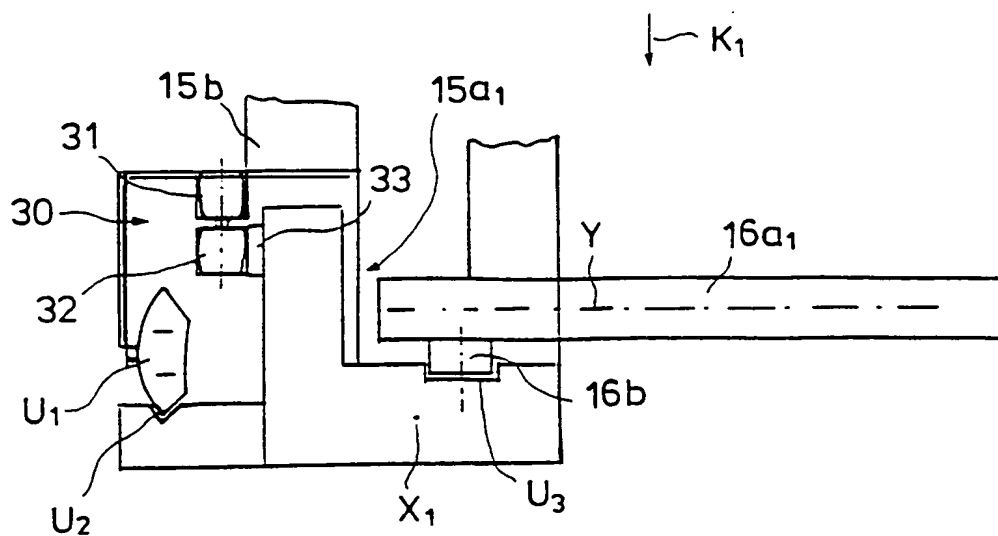


FIG. 2C

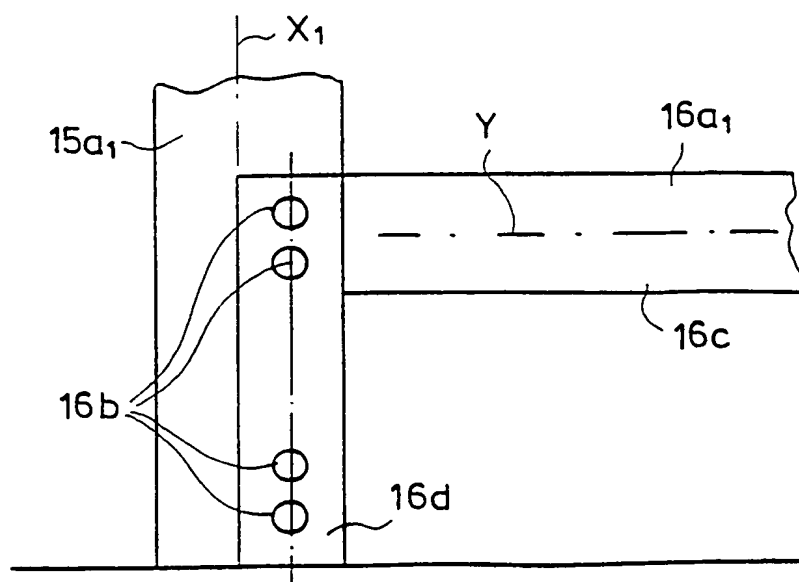


FIG. 2D

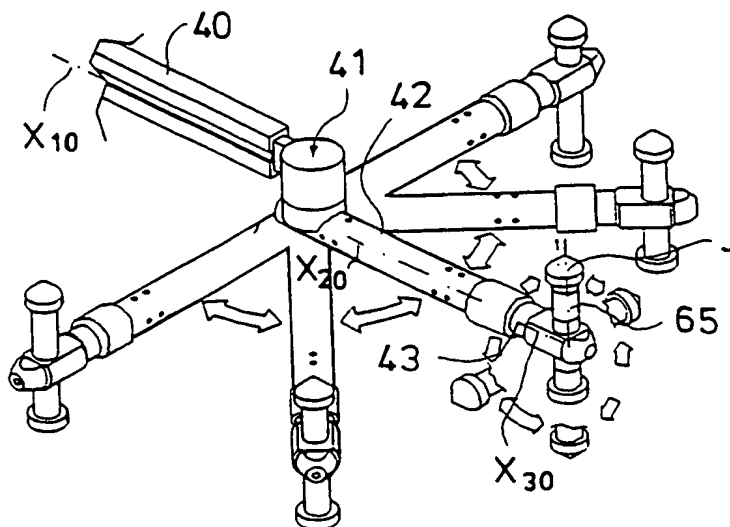


FIG. 3A

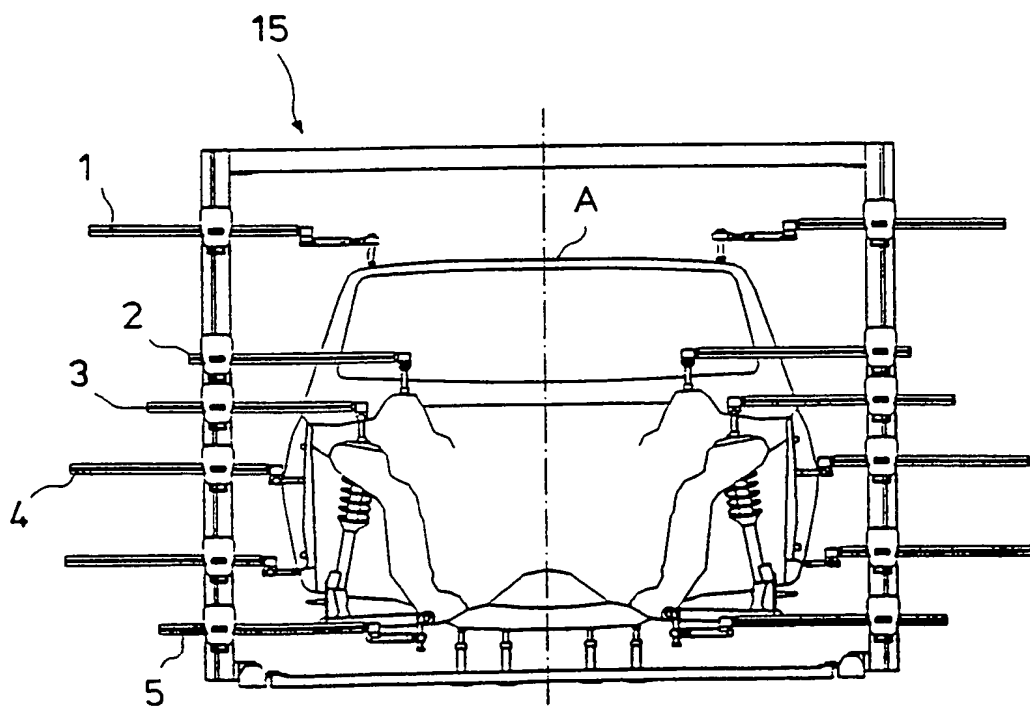
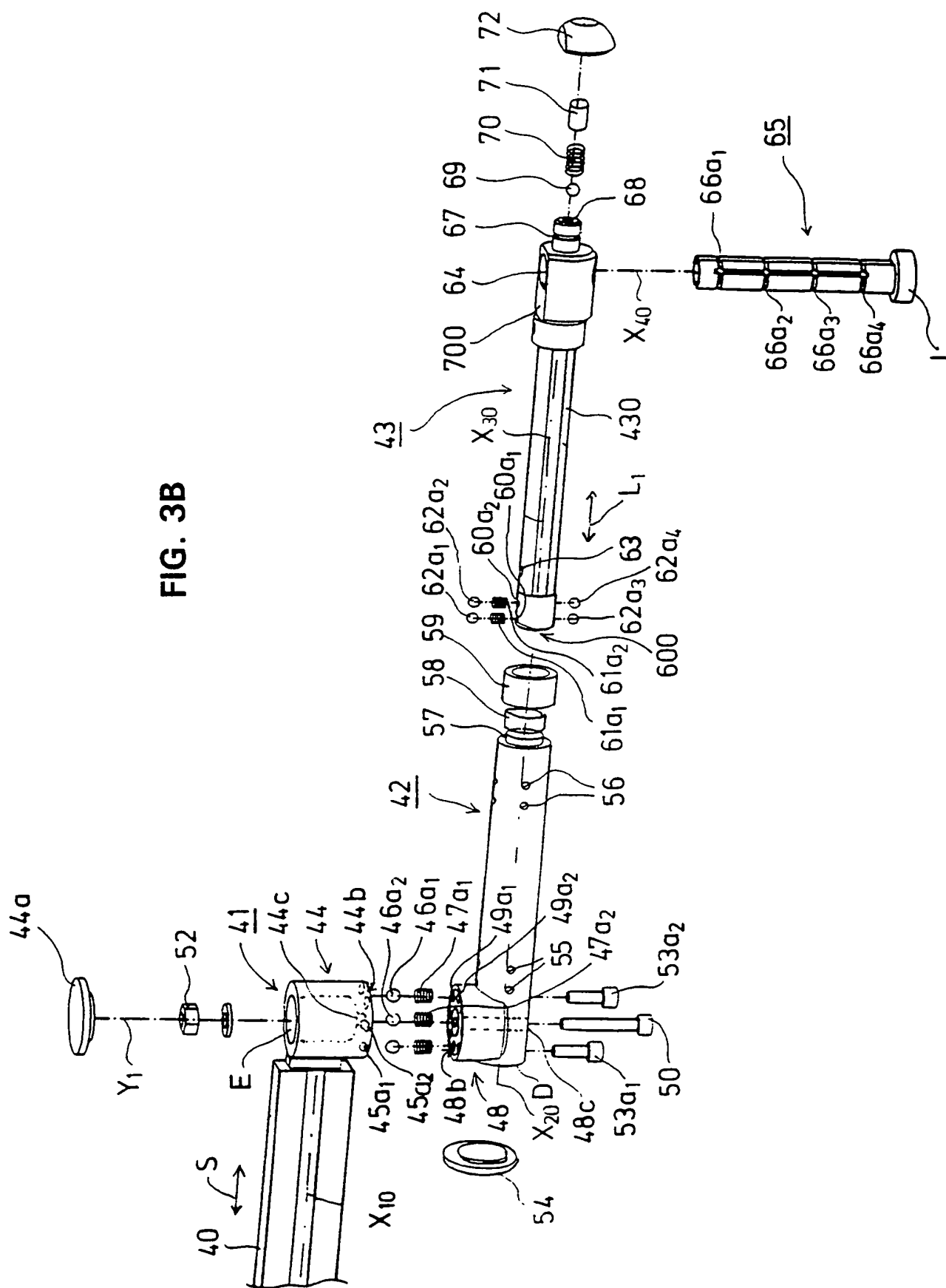


FIG. 4

FIG. 3B



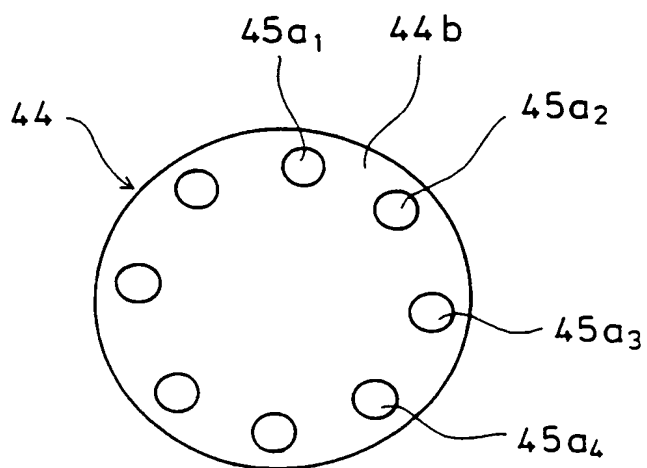


FIG. 3C

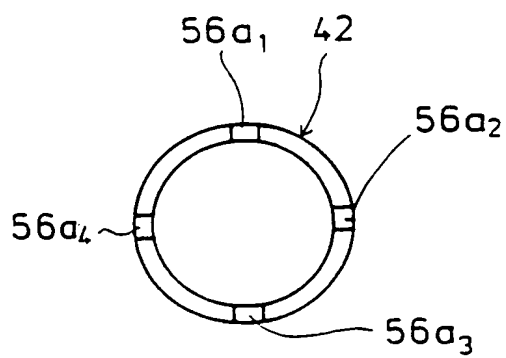


FIG. 3D

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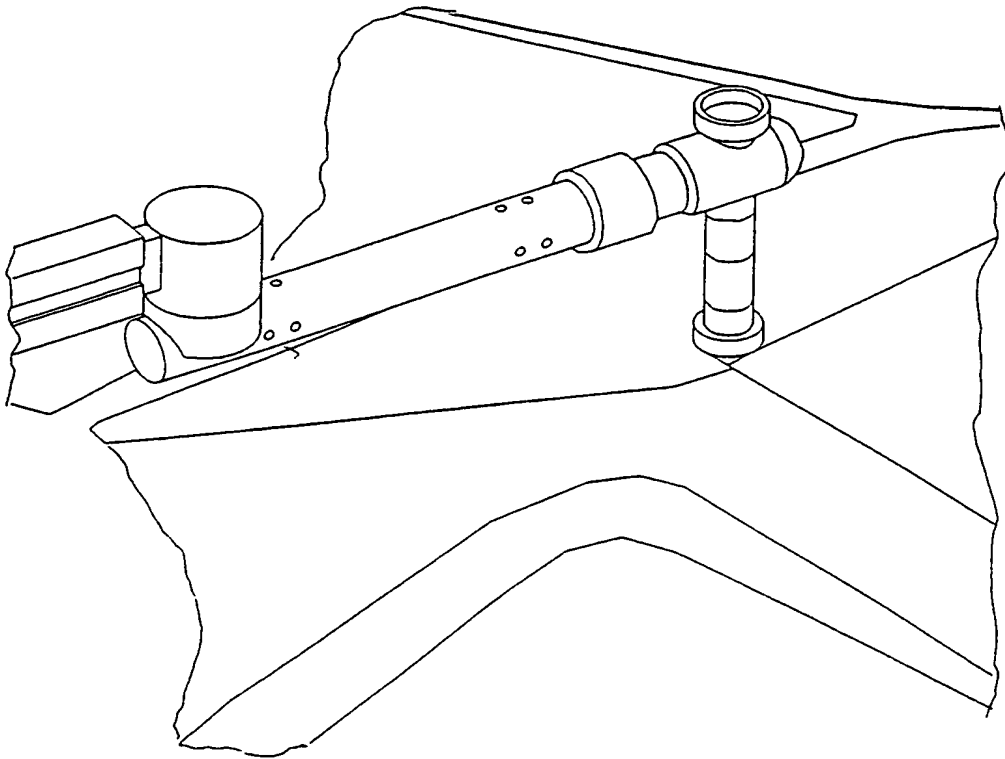


FIG. 5A

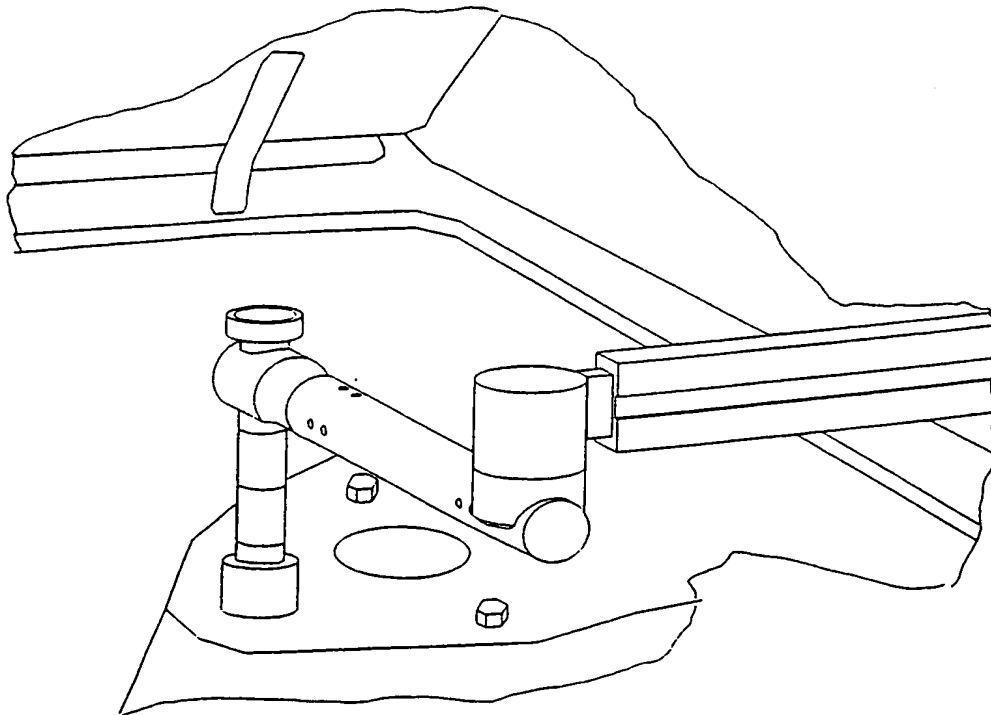
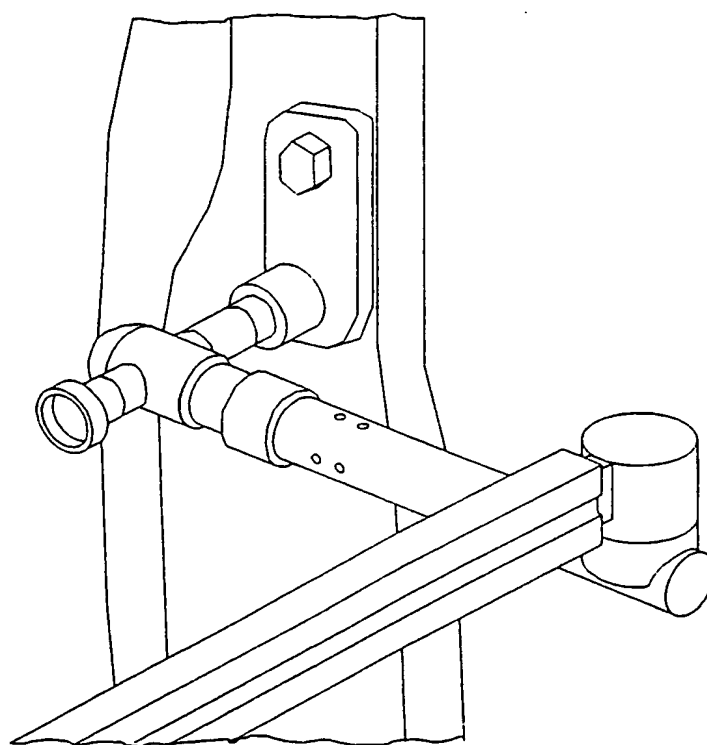
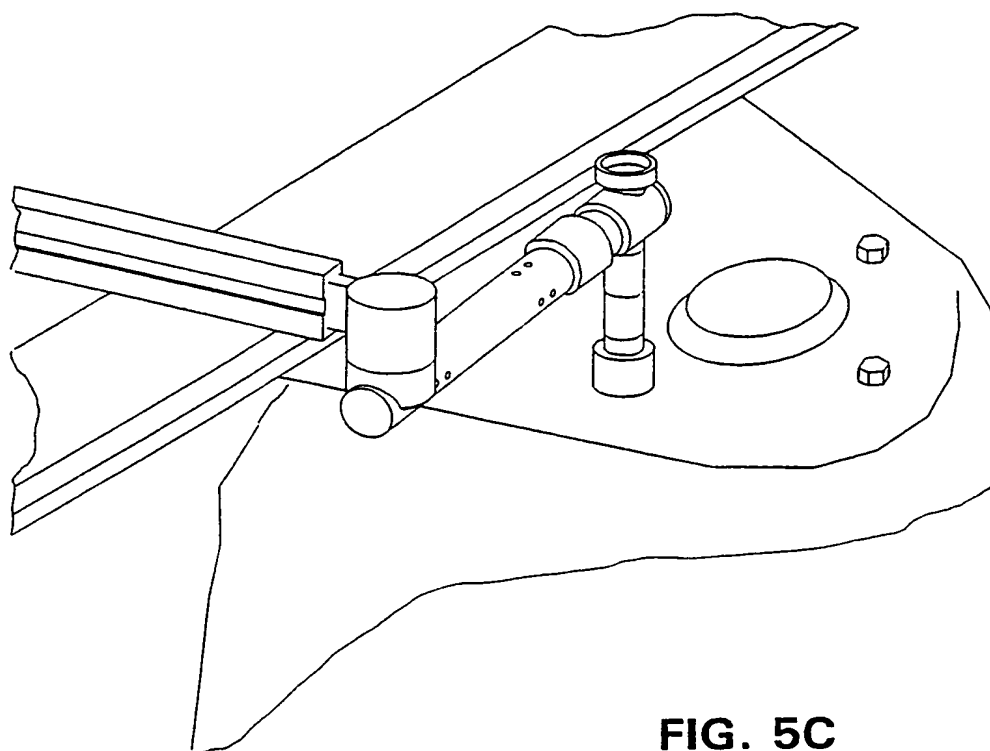


FIG. 5B

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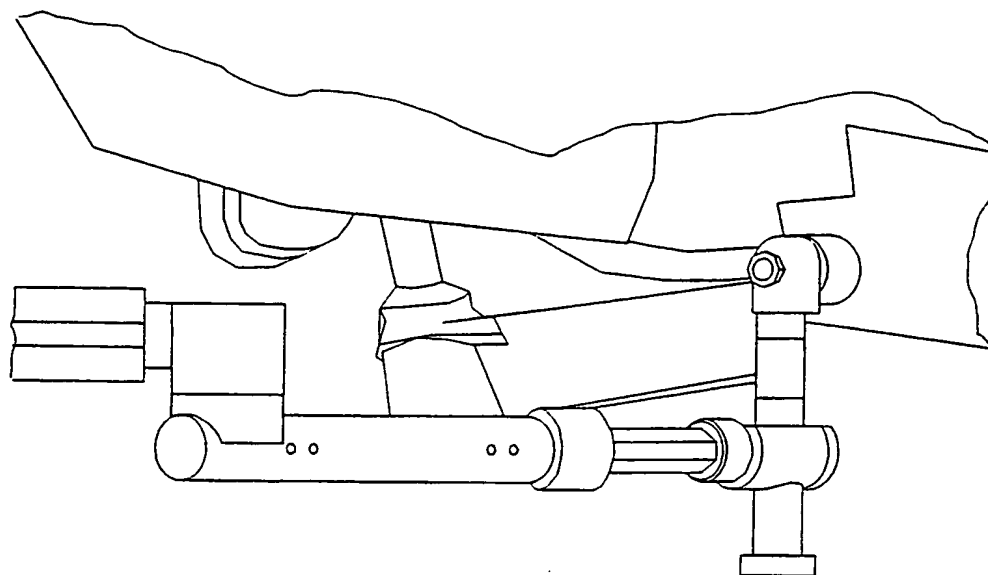


FIG. 5E

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00421

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B21D 1/12, G01B 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B21D, G01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5148377 A (MCDONALD), 15 Sept 1992 (15.09.92), figure 10, abstract --	1-10
A	US 4953306 A (WECKENMANN ET AL), 4 Sept 1990 (04.09.90), figure 9 --	1-10
A	GB 2100681 A (SAMEFA AG), 6 January 1983 (06.01.83), figures 1,5, claim 1, abstract --	1-10
A	FR 2703447 A1 (CELETTE PRODUCTIONS (S.A.)), 7 October 1994 (07.10.94), figure 1, abstract -----	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

19 August 1999

Date of mailing of the international search report

23 -08- 1999

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI 99/00421

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
US	5148377	A	15/09/92	AU 619171 B	23/01/92
				AU 1054688 A	30/06/88
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